CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

McGRAW-HILL PUBLISHING COMPANY, INC.

S. D. KIRKPATRICK, *Editor*

Volume 45 — *OCTOBER, 1938* — Number 10

# Security—Real or Fancied

IF PROOF WERE NECESSARY, the events of the past month have conclusively shown that human and social forces determine the course of all economic and political developments. What the eminent economist, Dr. Virgil Jordan, calls the "organic" factors in economics are clearly in their ascendancy. He sees a rising "energy level" among the peoples of Germany, Italy and Japan as contrasted with a steadily declining spirit of enterprise in the populations of the great democracies of the world. This lack of creative energy here and in Great Britain and France has resulted, he feels, from an overemphasis on security. We have occupied ourselves with a search for negative and false values while new energy groups have developed elsewhere—intent on aggressive action, ambitious for personal and national achievement. He holds that sooner or later we shall feel the economic impact of these more energetic countries.

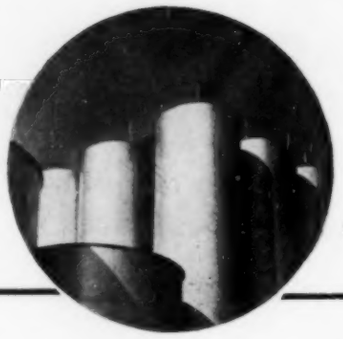
Many will not agree with the learned doctor in his diagnosis of world ills. But it must be admitted that many developments here have promoted "security-mindedness" — not alone among the masses but in industry as well. The government has persistently fostered an inferiority complex among business men. Congress helped to prepare us for the prevalent fear of war by passing a Neutrality Act that puts extraordinary powers into unpredictable hands. Perhaps it is time to revitalize our individual and national thinking——to show that our true strength and energy lie in individual and industrial enterprise.

Security can then take on new and broader meanings. For the individual it can mean the competence and satisfaction that come from personal achievement rather than from a government pension or public charity. Some of our people have become so discouraged that they do not realize that there can be no lasting security for any of us unless we make it ourselves.

For industry, still a different sort of security should be our true objective. Its synonym is stability of opportunity—certainty that the rules of the game are not going to be changed too often. The incentive of legitimate profits with some assurance that they will not all be confiscated by taxation is security enough for private enterprise under ordinary circumstances.

This brings us to what has lately seemed most important of all—our national security. Again we have been driven by fear of war into a false position. We have made ourselves believe that absolute isolation is not only possible but a necessary means of preventing foreign entanglements. We have set up an embargo on the export of certain arms and munitions and have invested the President with wide discretionary powers over raw materials and foodstuffs that are vitally essential to any nation in time of war. Yet we have given very little thought to that most realistic approach to security which comes from industrial preparedness.

Col. H. A. Toulmin, Jr., has recently said: "Modern armies subsist on industry and only because of industry. Industrial mobilization is the very essence of successful war. What is more important, it is the key itself to not having a war. The nation that has an effective mobilization of its industries is a nation that probably will never have occasion to use its manufacturing facilities for its armies." Postponement of war is not peace. The sooner we abolish such false ideas, the nearer we are to true security.



# From an

### PUT THE FACTS TO WORK

ERNEST BENGER of the du Pont company recently addressed the annual convention of the American Trade Association Executives, directing their thoughtful attention to the contributions of industrial research to the national welfare. He drew heavily on the chemical accomplishments not only of his own company but those of the universities and of other chemical industries. He presented a factual picture that inspired confidence and respect for American chemical industry. In short, he made a worthwhile contribution to what we sometimes call the industry's "public relations"—its responsibilities for public education and enlightenment.

Unfortunately too few technical men are willing to accept their share in this responsibility. False modesty or fear of being misunderstood keep many from accepting assignments to speak at public meetings or to talk to groups of people interested in what we are doing in the chemical industry and profession. Yet this participation is an essential part of a great educational program that must be advanced rapidly if our industry is to be properly understood and appreciated.

The necessity for such a program of public relations, and the practical steps required to put it into effect in the chemical process industries are clearly outlined on pages 541-556 of this issue. There, too, will be found some of the pertinent facts about chemical industry that can be used effectively in any presentation to fellow employees or to customer and community groups. Other sources of facts and figures are readily available. The important job for all of us is to put the facts to work in the public good.

### SOME QUESTIONS FOR MR. ICKES

A LOAN OF upwards of a half million dollars of American money for a sugar cooperative to build a plant in Puerto Rico to make butyl alcohol and acetone has been made by P. W. A. This is the latest announcement from the Puerto Rican Reconstruction Administration of which Secretary Harold L. Ickes is the administrator.

Those who surmised that this might be a case of the government going into competition with its citizens were told that the sugar cooperative was a purely private enterpise and that the load did not differ from similar grants to American chemical industries made by R. F. C. or other governmental agencies. We are not so sure about that. For one important reason, it is our understanding that R. F. C. loans are made only after thorough investigation of the economic and competitive situation. Surely no competent authority ever advised P. R. R. A. that there is any shortage of butyl alcohol and acetone in this country. Two more abundant and competitive chemicals could scarcely be found.

But just assuming that this is not putting the government directly into the chemical business, we have some other questions we would like to ask Secretary Ickes. Where are these solvents to be sold? Is it true that they may be used to supply the government's own purchases of these commodities? In that case, won't the producers come under the Walsh-Healy act and have to meet certain American labor standards? Will the wages-and-hours law force the Puerto Rican cooperative to pay the same wages that are paid in the United States? On the other hand, if the low wages prevailing in Puerto Rico are paid, will it be fair to put the products of a government-financed industry into competition with the products made from American corn or other American raw materials, in American plants, paying American wage scales?

Perhaps it is embarrassing to ask the generous secretary to answer all these hypothetical questions. Yet they apply to a very real problem. The American chemical industry is entitled to some explanation of why taxpayers' money is being used to create this unfair and uneconomic competition.

### INTERPRETING 1939 TO 6939

THERE IS SOMETHING vastly stimulating to the imagination in the thought that in the Westinghouse Time Capsule, 50 ft. beneath the surface of the ground at the New York Worlds' Fair site, scientists of 5,000 years hence will find a selection of objects and microfilm sufficient to give them a very fair notion of what life was like in 1939. A man's pipe, a women's hat, pure metals, alloys, textiles, a cellulose sponge, plastics, a golf ball—these and many other things will help future archeologists in their reconstructions, but much more important will be the more than 10 million words that have been compressed on microfilm. The equivalent of more than 100 books, the text has been carefully

# Editorial Viewpoint

chosen to give the best possible idea of how we work and play, what we know and do, our science, our religions, our philosophies.

But there is a sterner side to the time capsule and its contents than simply the probability that it will help future archeologists to dissect our civilization with the least possible effort. There is the distinct possibility that, rather than giving them a little quiet fun with our naive ways and elementary knowledge, the capsule's content may be the means of rediscovering for them lost arts which in the intervening years disappeared in a world gone mad. Man's brain has had the capacity to discover some of the most elusive secrets of nature and yet it has helped him not one whit in living with his neighbors. If social sciences cannot catch up shortly with discoveries in the world of material things, this second function of the capsule may become the important one.

### NON-TECHNICAL TECHNOLOGY

A FORWARD STEP which far-seeing engineers hope is the beginning of a new trend in engineering education is being taken this year at Carnegie Institute of Technology at Pittsburgh. Under the direction of Willard E. Hotchkiss, former president of Armour Institute of Technology, a program of social studies is being inaugurated which will have as its objective the development in the young engineer of a greater social consciousness and responsibility. When fully under way, the new program will consist of a series of related social and cultural courses which will occupy approximately one-fourth of the engineering student's studying time, the remaining three-fourths to be taken up by the usual engineering and science subjects.

It has long been the feeling of many, including President Robert E. Doherty of Carnegie, that the engineer has not assumed sufficient responsibility in our economic life, that he has given too little thought to the social consequences of the technological civilization which he has been instrumental in creating. Certainly there is ample evidence of this in our daily observations of the growing struggle of social adjustment to keep pace with industrial progress. In combating such conditions, it is logical that the place to begin is in our educational institutions.

Many schools, it can be said, have already taken steps in this direction by increasing the non-technical requirements in their curricula. Carnegie, however, is tackling the problem in a more direct and intensive manner than has been done before, and let us hope that it can be interpeted as evidence of a growing realization that men *are* as important as machines in this civilization of ours.

### HARALD AHLQVIST, 1876-1938

CORONARY THROMBOSIS last month claimed its fifth victim from among our chemical engineering leaders when Harald Ahlqvist was stricken on board ship and died in Kingston, Jamaica on September 6. Like Compton, Wilson, Herty and MacKay, he was a man in the prime of life—at the very peak of his ability to contribute to the advance of the industry and profession. His passing leaves a place in the alkali industry which will be difficult to fill. His work had received international recognition. Yet in this country he was known best only to those in his specialized field. His modesty prevented him from capitalizing more fully on his great knowledge and experience. Even among chemical engineers, few realize that Harald Ahlqvist was among the first to investigate and establish the logic of the Southwest as an important center for alkali manufacture. Although he had little to do with the establishment of the three large plants in that area, they may well be regarded as a great monument to the vision and judgment of a far-seeing engineer, a true gentleman, a trusted and respected friend.

### DANGEROUS COLORS

BRIGHTLY COLORED CHINAWARE must be made and marketed with care. Governmental officials find that some of the brightest reds, yellows, greens and blues of this tableware are achieved with colors and glazes which give the serious possibility of soluble toxic materials that could contaminate foods stored in or eaten from such dishes.

The makers and marketers of such pigments, as well as the ceramic industries, must take notice. All can well be guided by the new test, particularly for lead, which has been devised in cooperation with the Food and Drug Administration. The industry may find itself in serious difficulty if it does not safeguard the use of its materials in this fashion.

# Moisture Control by New Process

*What is certainly a new method suitable for controlling moisture in many materials, and possibly even, as considered by the author, a new unit operation of chemical engineering, is the Guardite process for "goods conditioning," which is described herein as applied to tobacco in the St. Louis plant of Liggett and Myers Tobacco Co.*

R. S. McBRIDE
*Editorial Representative*
*Washington, D. C.*

CONDITIONING of goods for moisture control is practiced in many divisions of process industry. But the consideration of this operation as a distinct unit operation of chemical engineering is rather unusual. Like many new ideas it is being stimulated by a specific development which mechanizes this operation and makes for distinctive chemical engineering practice.

The first installation of this type of equipment by Guardite Corp. for the treatment of an industrial commodity in chemical process industry has been made at the tobacco plant of Liggett and Myers, St. Louis, Mo. That installation for tobacco processing is quite spectacular. But to get the full chemical engineering significance of the installation one should disregard tobacco specifically and think of it merely as an industrial commodity in which it is desired to adjust quickly the moisture content in bulk. That operation, "goods conditioning" we should call it, is typical of many problems of process industry.

Ordinarily tobacco, after its original drying in hands, is packed for storage in hogsheads, each holding approximately 1,000 lb. of dried tobacco. In this form it is stored for two or three years during which period a certain amount of fermentation and curing occurs automatically. At the end of the storage period the tobacco contains only 7 to 9 per cent of moisture and volatiles. Before further processing the moisture content must be increased to about 14 to 17 per cent; and it is particularly important that the moisture content of the stems be raised to this figure. This is necessary to make the stems tough and pliable so that the leaf section is easily stripped off in the stemming machine without breaking the coarse central vein section of the leaf.

In the past tobacco was remoistened by exposure for several weeks to a warm humid atmosphere in "sweat rooms." Even that slow and costly operation does not always get uniform treatment of every leaf from those on the outside next to the hogshead to those buried nearly 3 ft. deep in the center of the mass. The Guardite conditioning process accomplishes this moistening operation with tobacco direct from storage in about 1 hour and the entire contents of the hogshead is brought to a uniform condition so that every leaf behaves almost exactly alike in the stemming machine. This operation also delivers the tobacco from the conditioner at the desired temperature for stemming. Hence it is not necessary to use an "ordering box" as is originally required for heating the tobacco after sweat-room treatment.

The principle of the Guardite conditioning process is very simple. The goods to be treated are placed in the vacuum chamber and the bulk of the air is withdrawn by a mechanical vacuum pump. When the pressure has been lowered to about 5 lb. absolute (⅓ atm.), then auxiliary or booster vacuum units are started. These assist in carrying the pressure down below that point at which water boils at the temperature prevailing in the vacuum tank. Thus, moisture in the goods being treated tends to boil out of the goods and washes out of the mass of goods any residual or absorbed air and other non-condensable gas. The removal of this residual non-condensable gas is extremely important, in order to open up all the mass to moisture access.

When the desired low vacuum has been reached, hot water is introduced by spraying through fine jets at a temperature predetermined to be the optimum for the operation being conducted. About 10 per cent of this water flashes into steam and the rest into extremely fine droplets which the operators call "micro-mist." Because the air has been completely removed from the chamber, even washed out of the interstices by the vacuum-boiling operation, the moisture is free to penetrate immediately and uniformly to every part of the goods being processed.

As the water is injected, the pressure in the tank is, of course, raised, usually to about a third of an atmosphere absolute. The goods are allowed to remain at this pressure through a short holding period, in order that the moisture which has been introduced as mist may be soaked up by the goods. It is evident, however, that this movement of moisture from one point to another can take place only through very small distances, probably only between the surface and center of a single part of a leaf. It is probable, in fact, that there is merely a soaking up by the goods of the droplets on the surfaces to which they were carried when the vacuum injection of the water occurred.

If more moisture is needed in the goods the tank is again evacuated down the boiling-point pressure and then more water sprayed in. This cycle of evacuation and moisture addition is repeated as many times as necessary to secure the desired re-

sult in water content. This repetition is, of course, better than any attempt to put in all of the moisture by spraying a large volume of water at a single operation, since that would not give as uniform distribution through the goods.

The final stage of conditioning provides for bringing the goods to the temperature desired for the next process. In the case of tobacco this is 130 to 140 deg. F. To warm the goods to this temperature desuperheated steam is used. Before this steam is introduced the tank is re-evacuated in order that the heat of the steam will be given up to all parts of the mass of goods when it rushes into the evacuated spaces, not merely given off on the outer surface of the hogshead. In other words, B.t.u. are enabled to distribute themselves uniformly just as was the "micro-mist." When the temperature has thus been brought to the desired point, the vacuum is broken by allowing air to enter the tank, the doors are opened and the goods are ready for removal.

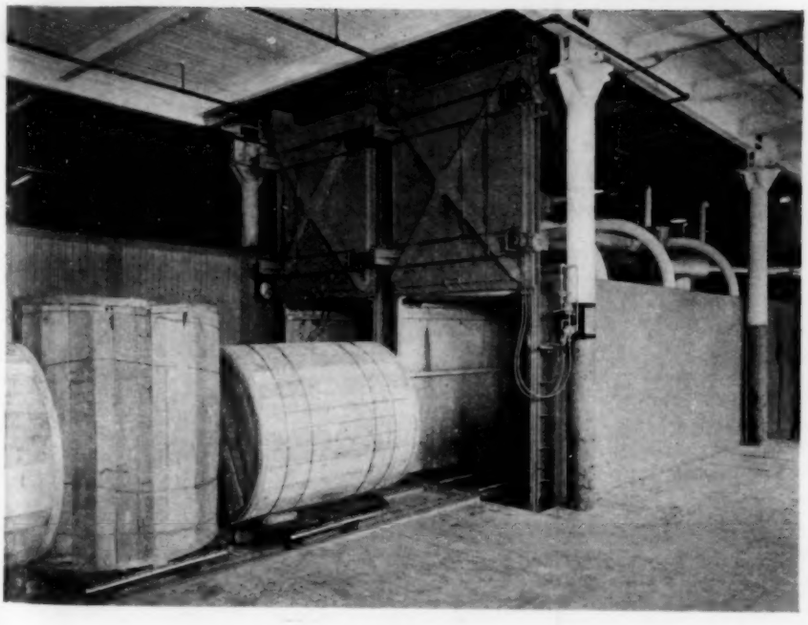
As a matter of fact, goods can be removed from the vacuum conditioning chamber at almost any temperature which is most advantageous for the next operation. This adjustment of temperature and moisture content is achieved by the quantity and temperature of the steam used. By a final "boiling" during the last evacuation, the mass of the goods could, if desired, be cooled somewhat while taking out only a little of the moisture, *at a low pressure*. If desired the goods can be removed at practically room temperature. It is of interest to note that cooling by such vacuum boiling of tobacco lowers the temperature by about 10 deg. F. for each 0.5 per cent lowering of moisture.

There are many important operating details to be considered in the planning of the Guardite conditioning process and in the control of the plant operation. But, regardless of those details, which will vary from one kind of goods to another, the fundamental principle is the same. The goods to be treated are sufficiently freed from inert and non-condensable gas so that every part of the mass is accessible to the injected moisture. A small part of this moisture is put in as vapor. But a major part may be put in with greater effectiveness in the form of the very fine mist which travels throughout the porous mass almost as if the droplets were in a gaseous condition. This is one of the important principles which underly the basic patent by Merriam and Wiles (U. S. Pat. 2,080,179) on which the Guardite development is based.

The Liggett and Myers installation which is illustrated by a number of accompanying pictures consists of two vacuum tanks, each a bit over 5 x 6 x 70 ft. inside dimensions. These tanks are built of $\frac{3}{8}$-in. steel boiler plate, with stiffening ribs around the outside welded fast to hold the plate in shape against the pressure of the atmosphere when the tank is evacuated. The closure at either end of the tanks is by a large ribbed steel door which seats against a double-V-type rubber gasket set in the door flange of the tank. As indicated by the diagram, there are suitable connections for vacuum lines, water and

**Interior view of Guardite conditioning tank showing water jets and desuperheated steam inlets**

**Entrance end of Guardite conditioning units showing tobacco hogsheads on dollies; note door sealing cylinders**



steam inlet, and air inlet to break the vacuum.

A train of 17 hogsheads is lined up on the track opposite the charging door of the tank. This train is then drawn into the processing chamber by a small cable which connects it with the previous train in the chamber. Thus, a single winch operation withdraws a completed charge and introduces the next group of 17 hogsheads for processing. Air-cylinder units on the roof of the tank provide for quick lifting and lowering of the closure doors, while an auxiliary small ram system of four cylinders on each door of the tank draws the door snug against the gasket once it is placed in the correct vertical position in front of the opening.

As it requires only a few seconds to open the doors and an equally brief time for reclosing after charging, the entire time lost between completion of one processing cycle and the beginning of processing on the next batch is limited almost altogether by the dexterity of the operators. It is expected that less than 5 minutes will be required altogether when routine operation is maintained. Since the processing cycle itself is of approximately 50 minutes in length, there is a comfortable margin in the operating plan for one complete cycle per hour. Thus, with two tanks, an 8-hour shift at this works can handle approximately 135 tons of tobacco per day.

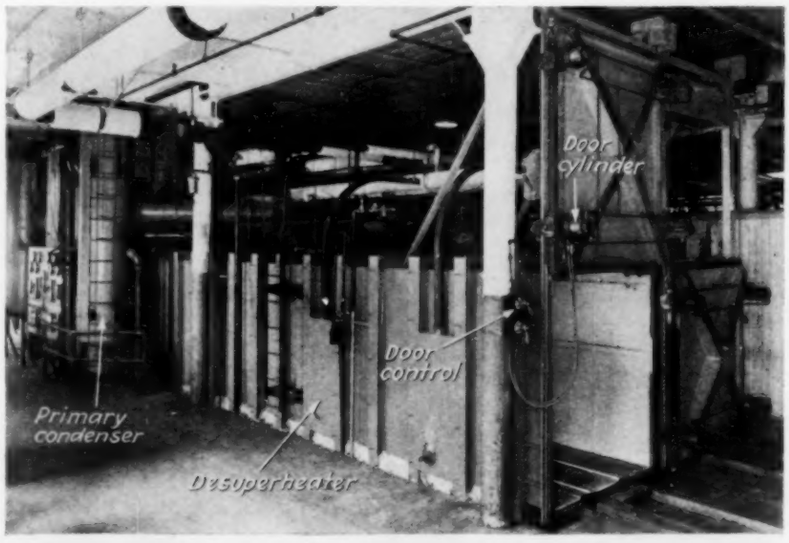
When treating grain or other free-flowing material the conditioner is built in the form of a cylindrical tank with hopper bottom. The goods to be treated then flow in and out by gravity, being delivered above and removed below by suitable belts or conveyors. In such cases hydraulically operated valves replace doors, but the fundamental nature of the cycle operation is the same.

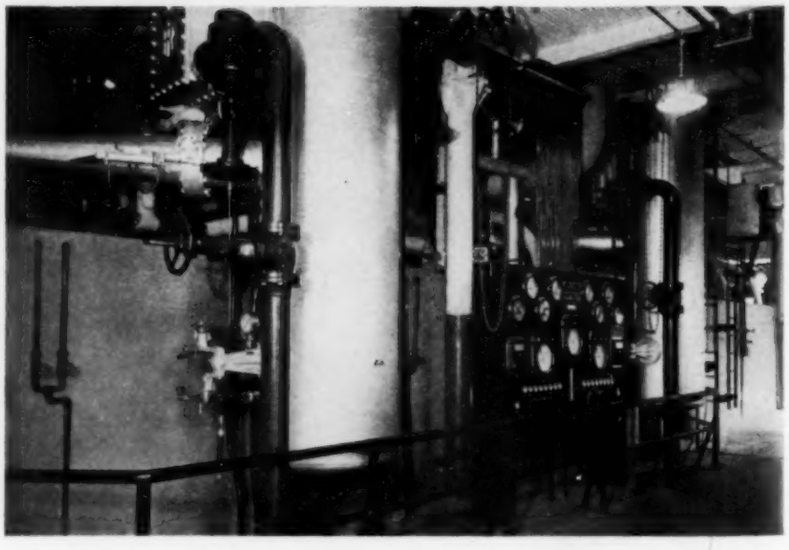
The normal cycle of processing any particular type of goods is worked out as a compromise between speed, which gives the greatest equipment capacity consistent with uniformity of product, which may be harmed by excessive speed. However, the uniformity achieved by this special type of vacuum processing is far greater than is feasible if the non-condensable air is not washed out of the interstices of the mass before moisture is introduced. Removal of this residual air cannot be accomplished until the equipment holds a vacuum a trifle below the boiling point of water at the temperature prevailing in the goods. Mechanical vacuum pumps could perhaps draw that vacuum; but the time required would be excessive and the capital investment for the installation will be much more than by using a combination of mechanical and steam-jet exhausters. The Guardite equipment, therefore, provides that as soon as the initial mechanical pumping brings the pressure down to a few pounds, the auxiliary "booster jets" are started. Steam consumption for these units is somewhat greater per pound of air removed at low vacuum than for engine-driven pumps (though not at high vacuum). The evacuating capacity which can be achieved with a minimum investment cost far outweighs this slightly greater operating item. The combination gives quickly a pressure reduced to 0.1 lb. abs., if needed.

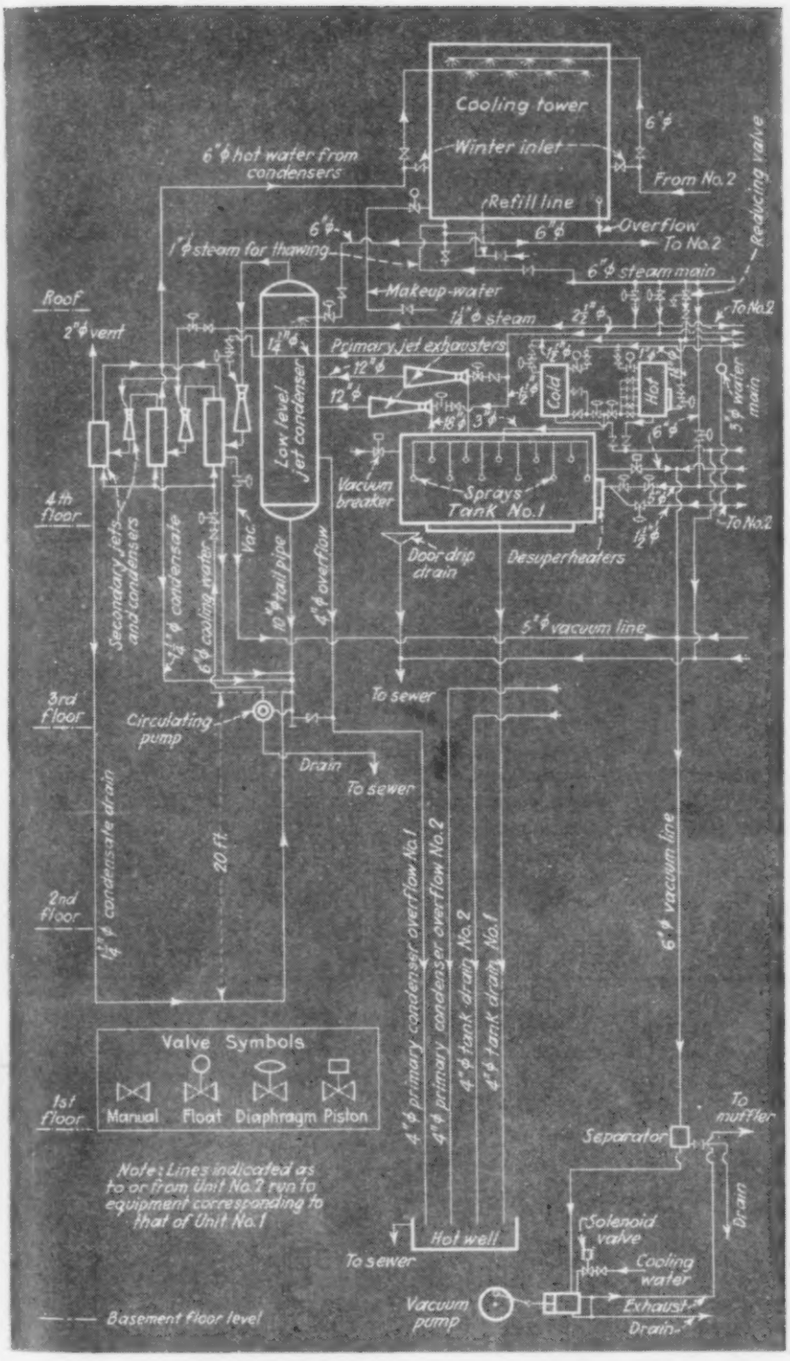
Both the temperature and the quantity of water introduced for moistening the goods must be carefully controlled. The water tanks are, therefore, so arranged that with relatively simple valve changes the water level can be set for both cold water and hot water at the desired point. Then the automatic functioning of the water valves can take in just the requisite proportion of hot and cold water in order to give the cold steam, properly subdivided into fine mist, at the optimum temperature for the requisite treatment of the particular goods. The preheating of the hot water is done

Guardite units during construction before application of insulation

Control panel flanked by primary jet condensers; note one jet vacuum booster and control valves






**Schematic piping diagram of one unit (not to scale) showing all principal lines and valves, except for door operation**

by high-pressure steam in a pressure vessel tank which permits use of water above 212 deg. F. when desired.

The St. Louis installation provides a completely automatic control for the operation of this equipment. A series of cams on a single shaft actuates in proper sequence small air-controlled units which in turn open and close the large air-operated valves on each part of the equipment. Once the cycle for any particular kind of goods has been worked out, the operators in charge need know nothing of the why, or the how, or the timing. When they have the tank charged and doors closed, they push the starting button. The automatic controls do the rest. Furthermore, the operator is unable to interfere with the cycle until the entire operation has been properly completed and the door locks are again released for opening.

The accompanying illustrations show the complexity of the control board which accomplishes this operation so effectively. But no pictures can show the simplicity of the operation which has been made so nearly fool-proof. Safety considerations made it desirable to place the door controls at the end of the tank. This location forces the operator to stand where he can see into the tank and thus, almost automatically, compels him to look in to be sure no workman is inside before he releases the safety catches and closes the doors.

All of the controls, for every part of the apparatus except door opening and closing, are centralized on the instrument board. The young forest of copper-tubing connections required for this purpose is shown above the instrument panel in one of the accompanying illustrations. Small indicating instruments show the operator not only the status of the operating cycle, but also prevailing conditions of temperature and pressure at each important point in each unit. Automatic recording instruments make daily charts of pressures and temperatures so that a permanent file may be kept in the laboratory showing the history of each lot of goods processed.

The automatic control is maintained by a rigid cam shaft driven through an electric frequency-motor or clock-type mechanism, actuated from the 60-cycle current supply of the plant. When the operating plan for a particular type of goods has been fixed, this timing mechanism is locked in place and modification of the cycle is not within control of the operator. The operator is able to turn the mechanism on after the doors are closed and he can stop the mechanism in case of need at any particular time. But it must then be restarted to complete the cycle, for he cannot open the doors after the operation has once been started until the completion of the cycle; but after the vacuum is broken, the manually operated door mechanism is under the operator's control.

In addition to the automatic control which governs steam, water, air, vacuum, and other valves, there are installed a few accessory manual controls. These permit closing off or opening up certain connections in case the automatic cycle must be interrupted, or if other irregular operation is desired. Only the authorized

technical supervisor of a company will usually have access to this timing control unit; and, therefore, only he can adjust the cycle from one to another type of goods. The supervisor can also make manually other adjustments in the cycle if needed.

The tank proper had to be assembled on the job from sections approximately 6x6x12 ft. in size. These and the other major parts of the apparatus had to be hoisted to the fourth floor where the equipment is located and drawn in through a window, as elevator and stairways were not sufficiently large for many of the unit pieces. The tank was assembled by welding; and the stiffener I-beams surrounding it were welded securely fast to the shell on the outside, spaced 2 ft. on centers.

The greater part of the accessory equipment such as water tanks, vacuum lines, operating valves and the multitude of piping connections was put on top of the tank in order to conserve floor space. In order to facilitate service and maintenance work the various lines are painted in harmony with the color scheme used by this works. Hot and cold water, steam, drain, and other pipe lines, each has been finished in the color utilized throughout the rest of the plant.

Since all of the valves are actuated by air pressure it did not seem altogether safe to depend on the compressed-air supply of the works for this facility, without some emergency standby. Therefore a small electrically driven air compressor was mounted on the roof of one of the tanks, close to the air storage cylinder. If, for any cause, the air pressure in the plant line should drop below a predetermined point, this compressor will pick up the load and insure that the treating unit has adequate compressed-air supply for valve operation.

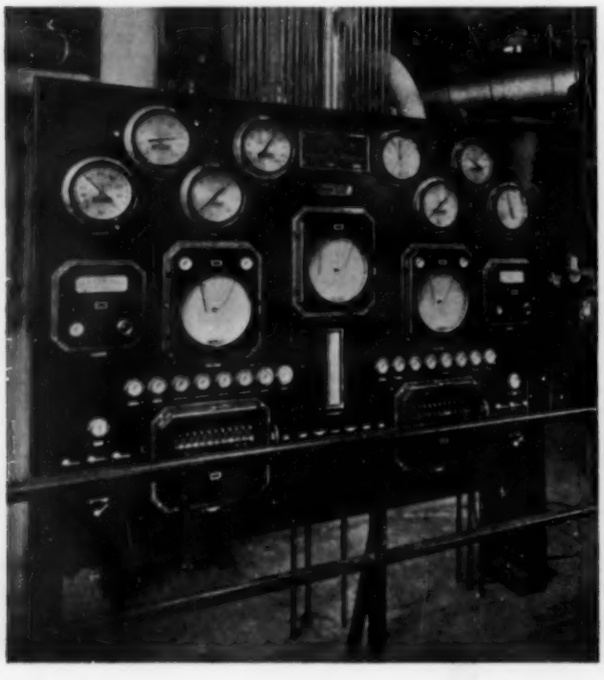
Cooling water for the condensers was not over abundant at this plant. It was decided, therefore, to reduce water requirement by recooling of the used water in the forced draft spray-type cooling tower on the roof. The net saving from that installation will retire the modest extra investment within a few months.

There is a very definite indirect advantage of this water cooling system. Normally, the water leg of the condenser would have to be at least 30 ft. long to prevent breaking the vacuum by reentry of air backwards through the condensers and vacuum lines. Although such long vertical connection was feasible, a considerable simplification was effected by modifying the connections. The water circulating pump at the base of the condenser leg draws water from the bottom of the short condenser leg, about one-third of the usual 30 ft., and forces it up to the sprays in the cooling chamber on the roof. This pump suction is, therefore, the equivalent of a longer barometric leg because it maintains a lower pressure head at the bottom of the condenser while pumping nearly 30 ft. up from this point into the sprays.

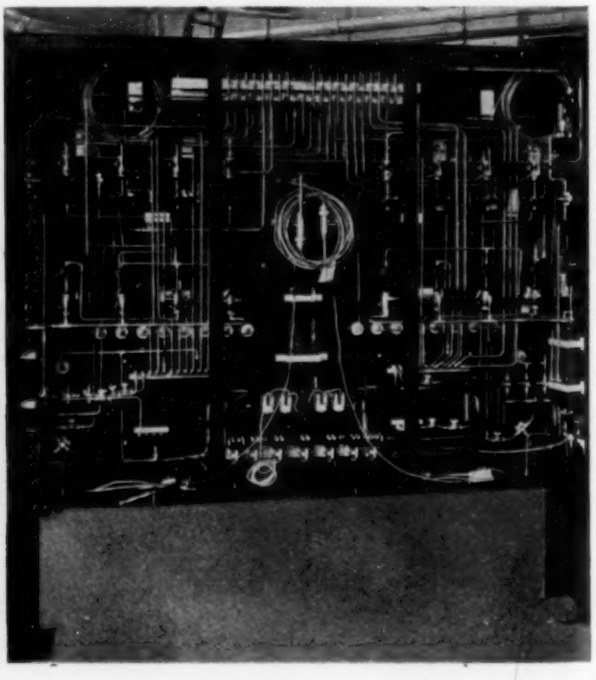
Great emphasis should be placed on the general nature of this method of goods conditioning. A procedure which can be applied to a 1,000-lb. mass of tobacco packed in a hogshead, 4 ft. in diameter and 54 in. high, can presumably be equally well applied to almost any other bulk package of industrial goods or a tank full of grain. The principle of eliminating fully the non-condensable atmosphere in order that moisture will have immediate and free access to every part of such a mass is fundamental. Using that patented principle, chemical engineers will presumably be able to process almost any type of material.

Already the Guardite Corp. has made a number of other applications of this procedure to cereal grains and other goods. The uniform success achieved would indicate that this vacuum process for goods conditioning is justifiably called a new and important unit operation of chemical engineering.

Control panel showing two cycle controllers at the bottom with recording and indicating instruments above



Back of control panel before installation showing numerous control tubes ready for connection to automatic valves



# New Chemical Fibers Surpass Silk

*New synthetic fibers showing exceptional physical properties that rival those of natural silk are in the process of commercial development. Two of these, Fiber 66 and "Vinyon," are expected to appear on the market sometime in 1939.*

A NEW SYNTHETIC FIBER whose superior elasticity, strength and water resistance may enable it to displace further silk and several other natural products of commerce has been developed by E. I. duPont de Nemours & Co., Inc. Though not yet officially announced, the new material, known as Fiber 66, has for some time been the subject of trade talk which within the past month seems to have been substantiated by the issuance to the duPont Company of U. S. Patents 2,130,947 and 2,130,948 covering the preparation of "new and valuable compositions of matter, particularly synthetic fiber-forming materials." Tests described in the patents show the new fiber to have far better elastic recovery than silk. This property may well enable it to penetrate the silk hosiery field, last remaining stronghold of natural silk.

### Chemical Composition

The new Fiber 66 is a thermoplastic polyamide resin formed by heating in substantially equimolecular amounts a diamine and a dibasic acid or an amide-forming derivative of a disbasic acid under conditions of condensation and polymerization until the product has a sufficiently high molecular weight to show fiber-forming properties. The temperature used is generally between 180 and 300 deg. C., and sometimes a solvent or diluent is employed. To avoid contamination the reaction is carried out in glass-lined or noble metal equipment. It is also necessary in order to obtain a light colored product to carry out both the preparation of the polymer and the spinning operation in the absence of oxygen. This means using a blanket of inert gas such as nitrogen, carbon dioxide or hydrogen.

A number of different combinations of diamines and dibasic acids are possible, and it is probable that several will be used commercially to give products of varying characteristics, depending upon their intended use. The melting points, for example, of some of the fiber-forming polyamides range from 157 deg. C. for that obtained from hexamethylenediamine and diphenic acid, to 278 deg. C. for that obtained from tetramethylenediamine and adipic acid.

No statement has been made regarding raw materials to be used in commercial production, but it has been learned from a reliable source that adipic acid will be the important dibasic acid and that this will be made synthetically. It is believed that a process starting with benzene and going through phenol and cyclohexanol to the acid will be used. The polymethyleneamines probably will be synthesized from primary hydrocarbons and ammonia. Production costs for the finished polyamides are high at the present stage of the development, but their eventual market price is not yet determinable.

### Spinning Characteristics

The polyamides can be spun into continuous filaments directly from the reaction vessel into the atmosphere. Or, they can be dissolved in a suitable solvent and then extruded into a liquid which dissolves the solvent but not the polyamide, or the solution can be extruded into a heated chamber where the solvent evaporates. By similar processes, bristles, sheets, ribbons, rods and tubes can also be formed.

A significant characteristic of the spun filaments is their ability to increase greatly in strength and pliability upon cold drawing. It is claimed that cold drawing, which may be as much as 200 to 700 per cent without breaking the fiber, leaves the filament permanently extended, much stronger and more elastic. Also, examination by X-ray shows true fiber orientation in the drawn filaments but not in the undrawn filaments. The cold drawing referred to here differs from stretch spinning known to the artificial fiber art in that it may be carried out in the absence of any solvent or plasticizer.

When spinning from the molten polyamide, speeds as high as 3,000 ft. per minute have already been achieved. Very fine filaments, as fine as 0.2 denier or less, can be spun, particularly if the filament is cold drawn while wet. It is claimed, in fact, that spinning improves as the denier of the fiber is decreased.

It has been mentioned that the outstanding characteristics of the polyamides are their elasticity and water resistance. In addition, high tenacity, high fiber orientation, good chemical resistance and exceptionally good aging characteristics in air even at high temperatures are claimed. Wet strength is generally at least 85 per cent of dry strength. The fibers are lustrous and silky in appearance but can be delustered by the ordinary methods and will take the common dyes readily. Though attacked by strong mineral acids such as hydrochloric and sulphuric, the polyamides will resist strong alkalis.

Data on polypentamethylene sebacamide fiber spun with 250 per cent cold drawing to a denier of 4.9 show a tenacity at break for the fiber of 7.1 grams per denier. Spun into fabric which was stretched 100 per cent for 3 minutes while wet, this material showed an elastic recovery of 80 per cent as compared with 32 per cent for a similar silk fabric. At 85 per cent relative humidity and 25 per cent stretch, the polyamide recovered 77 per cent as against 65 per cent for silk. Water resistance tests showed the polyamide to absorb about 12 per cent as much moisture as viscose rayon under similar conditions.

The new synthetic toothbrush bristle "Exton" is the first duPont polyamide product to appear on the market.

### Vinylite Resin Yarn

Another new fiber on which no technical information has been officially released but which is expected to appear on the market soon is Vinyon, a material produced by Carbide & Carbon Chemicals Corp. from the vinyl type of synthetic resin. Among properties of Vinyon of special interest are its high elasticity and elongation at break, high tensile strength as compared with rayon, resistance to water, acids and alkalis and good dielectric properties. It is expected that this fiber will be especially suitable for industrial fabrics.

# Manufacture of Dye Intermediates

*Two unit organic processes, sulphonation and condensation, are involved in the commercial preparation of quinizarine, an important anthraquinone dye intermediate. The design and construction of a small plant unit recently installed by an American dye manufacturing concern illustrates some of the engineering problems encountered in the production of this and similar organic compounds.*

**ARTHUR E. PINKNEY**
*Chemist*
*Commonwealth Color & Chemical Co.*
*Brooklyn, N. Y.*

QUINIZARINE (1:4 dihydroxyanthraquinone) has long been an important dye intermediate. H. E. Fierz-David in his "Kuenstliche Organische Farbstoffe" remarks that, "Quinizarine and its derivatives belong to those anthraquinone compounds which are most intensively investigated." But while there are several common laboratory syntheses of the compound, there is one process that has displaced practically all others commercially and is most commonly employed in dye intermediate plants today. Its general procedure is as follows:

Para-chlorphenol is disulphonated with oleum at 135-145 deg. C. for from 4 to 8 hours. The reaction mass is then diluted with 66 deg. Be. sulphuric acid, and boric acid and phthalic anhydride are added. This mixture is heated to 195-200 deg. C. with agitation and maintained at temperature for about 10 hours to insure complete condensation. The mass is permitted to cool to 80-90 deg. C. before discharging it into a "drowning" tank which may contain a weight of cold water from 5 to 10 times that of the condensation mass. The precipitated quinizarine is then filtered out.

In order to produce an efficient unit of low enough initial cost to make it practicable for even a small plant to manufacture its own quinizarine by this process, it was attempted in designing the present equipment to incorporate economy with technical and practical knowledge gained through first-hand experience with various types of quinizarine units. Three factors in particular were borne in mind: safety of the operator, ease of operation, and costs, both initial and operating.

As will be seen from the accompanying figure, the complete unit consists of a kettle for the disulphonation and condensation reactions, a wooden drowning tank, a chamber type filter press, and a Monel metal centrifugal pump. The kettle is direct-fired by a ring burner and the necessary air for discharging the product is furnished by a small compressor. The capacity of the unit is two 500-lb. batches per 5-day week. Operation is simple, maintenance and running costs are relatively low, and the product obtained has been satisfactory.

### Kettle and Accessories

The 600-gal. reaction kettle is of cast iron 1¼ in. thick, and is unjacketed. The blades of the anchor type agitator are also of cast iron and are fastened to the shaft with Monel nuts and bolts. The speed of the agitator is 30 r.p.m. It might be mentioned that after being used once a week for one year the kettle showed very little wear.

The most practical method of discharging a kettle of this type is by means of compressed air. The blowleg, which should reach to the bottom of the kettle, may be either stationary or removable. In this particular unit it is removable.

Frequently the author has been asked about the relative merits of stationary and removable blowlegs. Although there are opinions both ways on this subject, it is a safe rule to install a removable blowleg where the medium in which the reaction takes place is strongly acid or where an acid medium is raised to a relatively high temperature. Since a quinizarine condensation is agitated at a temperature of 195 to 200 deg. C. for ten hours, a metal pipe immersed in the reaction mass is exposed to a strong corrosive as well as abrasive action.

A blowleg often develops a hole in the side after several batches, generally near the surface of the liquid. This is not noticed until the operator tries to blow the batch into the drowning tank. That part of the batch which is above the hole in the blowleg is discharged, while the largest part remains in the kettle. If the blowleg is removable a new one can be installed immediately, but if a stationary leg has been used the maintenance man must wait until the kettle has cooled sufficiently before repairs can be made, and as a result valuable time is lost.

The blowleg in the present unit is made of 1½-in. heavy iron pipe and is fitted into the top of the kettle as shown in the drawing. Also in the top of the kettle near the side is a ¾-in. heavy iron pipe thermometer well. This extends to within a foot of the bottom of the kettle and is rigidly fixed to withstand the force exerted on it by agitation of the batch. As a safety precaution, the top of the well is threaded on the inside

so that a plug may be screwed into place before discharging the kettle. This precludes any possibility of blowing hot acid out through the thermometer well if the latter should develop a hole under the surface of the liquid. Slightly less than half filling the well is a mixture of lubricating oil and steam cylinder oil in which the thermometer stem is immersed. Temperature recorded in this way has been found to correspond very closely to readings taken directly from the reaction mass. Another ¾-in. pipe connection in the top of the kettle admits compressed air for blowing out the batch. A pressure gage and release valve are attached to the air line.

The kettle top has a regulation manhole over which is fitted a square wooden stack extending 12 ft. above the roofs. The lower end of the stack is so constructed that a section 3½ ft. long can easily be telescoped upward while the kettle is being charged. Inside the stack is an air jet for withdrawing acid vapors. During the condensation hydrogen chloride is evolved, and when the temperature rises above 150 deg. C. sulphuric acid fumes become quite noticeable. Some phthalic anhydride also sublimes at the high temperatures in sufficient quantity to occlude a vent of only 2 or 3 in. in diameter. The wooden stack was found to be quite satisfactory, and with the compressor set at about 15 lb. the air jet drew out all acid vapors.

The choice of a source of heat generally depends upon local conditions. For instance, if the quinizarine kettle is an addition to other sulphonators or nitrators which are heated by means of a Merrill circulating oil system or a Dowtherm system, the logical solution is a jacketed kettle which is connected to the heating system already available. When the unit is a separate installation, however, it has to bear maintenance costs and operating expenses alone. This happened to be the situation in the present case, and accounts for the choice of a ring burner as the most economical source of heat.

The burner was made by the local gas company at moderate cost. It consists of a 26-in. diameter loop of 2-in. iron pipe into which small iron cups are welded in an upright position. The cups have dished heads with twelve 3/32-in. holes in each head. The arm of the ring is connected to the gas line and to the air line from the small compressor. The flow of gas and air can be controlled by means of valves.

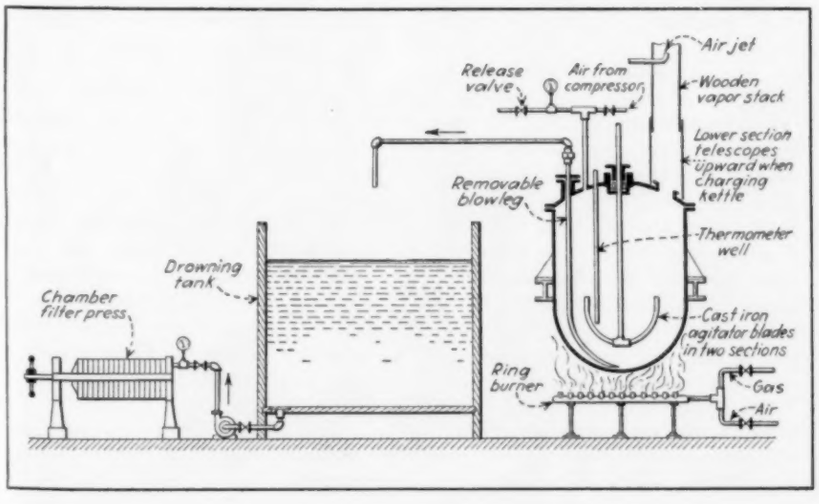
A square brick inclosure surrounds the kettle and burner up to within 6 in. of the top flange. A minimum air space of 6 in. was allowed between the sides of the kettle and the brick walls. The top of this space was filled with cement reinforced with heavy mesh wire and a 3-in. pipe was cemented in for proper venting.

Separating a solid from a 10 to 20 per cent sulphuric acid liquor which may vary in temperature from 60 deg. C. to 95 deg. C. presents a problem. In the case of quinizarine the choice is between a filter box and a chamber filter press. Each has its advantages and disadvantages. An iron filter box, lined with acidproof cement and acidproof brick and provided with a false bottom of porous filter brick, requires very little maintenance. The chief disadvantage, however, is its lack of flexibility, that is, it generally cannot be used for other purposes. Its idle time is high. Another disadvantage is the slowness of the filtration and the time required for proper washing, since the filter cake requires many hot water washes to render it free of acid. Even with a good vacuum this often requires from two to three days.

In the present unit, the quinizarine suspension is stirred in a wooden tank until the temperature has fallen to about 60 deg. C., when it is pumped into a chamber filter press through a Monel metal centrifugal pump. A batch yielding 500 lb. of finished quinizarine is pumped into a 36-in. filter press in from 45 to 50 min. Washing on the press with hot water for 5 to 6 hours gives an acid-free cake.

The only disadvantage in the use of a filter press is the necessity of rather frequent replacement of filter cloths. Some manufacturers also hesitate at the initial cost of a press. Regarding the replacement of filter cloths, the author has filtered from 8 to 10 batches before a set of cloths had to be replaced. Taking into consideration the ease of operation and the speed of filtering and washing, the filter press is cheaper than a filter box over a period of time. This is especially true when the variety of products that may be filtered through a press is taken into consideration.

**Unit for making 1,000 lb. of quinizarine per day. Para-chlorphenol is disulphonated with oleum and the resulting product condensed with phthalic anhydride. After complete reaction the mass is discharged from the kettle into a tank of water where the quinizarine separates out. It is then recovered by filtration.**




## Cosmetic Dyes Must Be Certified

COAL-TAR DYES used in the manufacture of cosmetics, drugs and foods must be certified by the U. S. Department of Agriculture under the new Food, Drug and Cosmetic Act. So that cosmetic manufacturers may not be handicapped by a lack of certified dyes when the new law becomes effective next June 25, the Food and Drug Administration is expanding the existing food color certification plan to include coal-tar colors intended for use in drugs and cosmetics.

# Attacking Trade Waste Problems

*The problem confronting plant managements today is not so often the question, Shall we treat our wastes? as it is the questions, How shall we treat?, What will be the cost? and Can valuable byproducts be recovered?*

G. M. DARBY
and
C. L. KNOWLES

*Director, Dorr Co. Laboratories, Westport, Conn., and Chemical Sales Director, Dorr Co., New York, N. Y., respectively*

IN PAST YEARS, articles on the subject of industrial waste treatment frequently commenced with a discussion of the social and economic evils of discharging untreated industrial wastes into bodies of water. Today, such an introduction to the subject is unnecessary for industry is now more keenly aware of the necessity for treating its liquid wastes than at any previous time in our history. The problem confronting plant managements today is not so often the question, "Shall we treat our wastes?" as it is the questions, "How shall we treat?", "What will be the cost?" and "Can valuable byproducts be recovered?"

We wish it were possible to give here specific answers to these questions for the particular wastes with which each reader of this article is concerned. However, the very nature of these industrial wastes makes this an impossibility. The wastes discharged from manufacturing plants wthin the same industry and making the same product may differ widely from each other in character and in hourly rate of flow. Thus there can be no substitute for an independent, open-minded study of each problem, regardless of established precedent.

We cannot, and do not seek in this discussion, to present a ready-made solution for any specific trade waste. Instead, on the basis of our experience with a great many waste treatment problems, we shall set forth the broad lines of approach which, when followed, are most likely to lead to the development of an effective and economical method of treatment. In addition, a number of waste treatment methods now in operation in different industries will be reviewed. From these, it is hoped that the reader may gain information which will be helpful in the solution of his own problem.

If a few exceptions are excluded, it is undoubtedly true that treatment methods, satisfactory from a technical standpoint, have been developed for practically all of the wastes commonly met in industry. Unfortunately, however, when examined from the standpoint of first cost or operating charges, some of these treatment methods prove entirely too costly to be used by industry. In such instances, further experimental studies and development engineering remain to be done before treatment methods, both adequate and economical, can be evolved. Time will be required in these cases, and where conditions make the necessity for a solution urgent, investigations by those skilled in solving such problems should be started promptly.

While it might be reasoned that problems of trade waste treatment are primarily ones for the chemical engineer, since he created these wastes, the knowledge of the biologist and sanitary engineer must often be drawn upon for a solution. This is particularly true where organic materials are concerned. In the greater number of cases such experts, due to their past experience, can specify the proper flowsheet and equipment combinations.

No opportunity should be overlooked to return a profit, or at least to defray a portion of the cost of treatment. Within our own experience, we have been associated with a number of waste treatment projects in which a portion or all of the treatment costs was returned from byproducts. These include the following:

Recovery and reuse of stock and filler contained in white water formerly wasted at paper mills.
Making of stock feed ingredients from packing house wastes.
Reclamation of valuable tin salts from textile dyeing establishments using tin for weighting silk.
Production of a medium grade fuel oil and a carbonaceous residue from pressure residue at oil refineries.
Recovery of animal hair from tanneries.
Reclamation of grease from wool mills.
Production of a fertilizer base from glue factory wastes.

We believe that investigations now in progress, looking toward the treatment of steel pickling liquors, will result eventually in a process that will yield a substantial credit to the steel mills. In addition, we know that the treatment of alcohol wastes, distillery slops and corn product wastes, yields merchantable stock feeds as a byproduct, although as yet we have not been directly connected with these projects. In spite of the profitable waste treatment operations cited above, and as a broad governing principle, the problem should be considered as a 100 per cent remedial one.

Industrial waste treatment problems may be classified broadly into three groups, based on the principal characteristics which render the waste objectionable and which therefore make treatment necessary. These classifications and some notes on each are as follows:

*Sand and Other Solids Removal:* Wastes containing sand and other settleable solids, unless treated be-

fore discharge into a stream, will deposit their solids on the river bottom in the form of sludge banks. In time this will lead to blocking of the stream or to reduction in the depth of the channel of navigable rivers.

*Method of Treatment:* Mechanical treatment involving one or more of the steps of classification, hydro-separation, or thickening.
*Typical Sources:* Blast furnaces, collieries, sand plants, glass grinding operations.

*Color and Turbidity Removal:* Color and turbidity from industrial wastes can lead to the destruction of the fish and other aquatic life of a stream and will frequently render the water useless for industrial or municipal use by those industries and cities located downstream. Furthermore, the corrosive nature of some wastes may cause serious damage to ship hulls, piling and other construction along the river front.

*Method of Treatment:* Chemical treatment involving one or more of the steps of flash-mixing, flocculation, clarification, filtration or centrifuging.
*Typical Sources:* Laundries, pulp mills, mine waters, dye houses, oil refineries, steel pickling, chemical plants, paper mills.

*B.O.D. Correction:* The B.O.D., or bio-chemical oxygen demand of a waste is the amount of oxygen, expressed in parts per million by weight, which is required to oxidize the organic matter in the waste. If an industrial waste with too high a B.O.D. is discharged into a stream, it will seriously deplete the dissolved oxygen in the stream and may bring about septic condition.

*Method of Treatment:* Biological treatment, including the possible use of aeration, trickling filtration, anaerobic digestion, and one or all of the mechanical treatment methods previously mentioned.
*Typical Sources:* Pulp mills, distilleries, breweries, dairy plants, tanneries, packing houses, canneries.

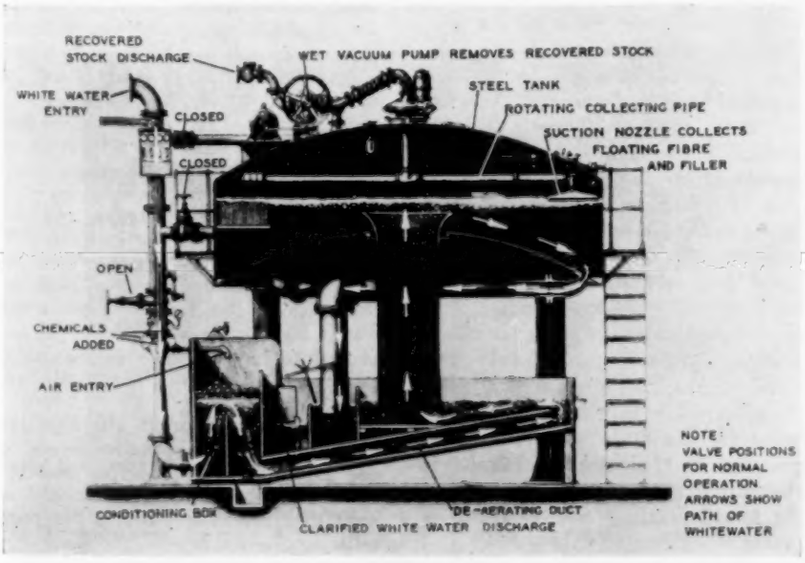
Thickeners and agitators treating effluent from a pulp mill

All industrial wastes will not necessarily fall strictly within any one of the three classifications given above; for instance, some wastes which require color and turbidity removal may also need B.O.D. correction; or those wastes containing sand or other solids may, in addition, contain color. In any case, however, the treatment will be by one of four methods, namely: (1) Mechanical (2) Chemical (3) Biological (4) Combination of any two or of all three of these methods.

In attempting a solution of any trade waste problem, the first thing that should be done is to make a complete survey within the plant. Facts which this survey should determine are:

(1) The source and quantity of flows of all wastes.
(2) Periodicity of flows.
(3) Character of flows—chemical analysis, pH, color content, settleable solids content, etc.
(4) Possible diversion of wash waters satisfactory for direct disposal.
(5) Possible changes in plant flowsheet which may eliminate, reduce, or reuse certain wastes.

Phantom view of a new type of white water saveall



(6) Degree of purification required if wastes are to be reused within the plant.
(7) Possible use of wastes from nearby plant as a cheap source of reagents. For example, lime for neutralization or flocculation.

At the same time, the authorities in control of the particular body of water in question should be consulted to determine the minimum degree of purification which will be required before the wastes can be discharged into the stream.

Before the expense of a separate waste treatment plant is incurred, three possible alternatives should be investigated, namely:

(1) The possibility of making changes in the process to bring about the complete elimination of the waste.
(2) Discharge of waste into the municipal sewerage system either without treatment or after partial treatment.
(3) Joint financing and operation of trade waste treatment plant with neighboring manufacturers.

These possibilities are discussed in turn below:

Complete disposal or partial elimination of an industrial waste by changing the process is extremely attractive, and this possibility should be the first to be investigated in seeking a solution for the problem. Unfortunately, it has been possible to overcome the problem in this inexpensive manner in only a few isolated industries. In the majority of cases, an industrial waste is the inevitable consequence of the manufacturing operation. A change in the flow sheet may alter slightly the concentration or composition of the waste, but, generally, a waste still exists, to be dealt with as the situation requires.

An exception to this general rule is the disposition of white water from paper-making machines. By the use of a new flotation type saveall not only is the discharge of paper stock to the stream stopped, but, in addition, the recovered stock is returned to the feed end of the paper machine and reused, and the clarified white water is brought to a clearness that permits its use almost anywhere in the paper-making process. Operating features of this saveall will be described in the latter part of this article.

Certain wastes are of such a composition that they may be effectively reduced to a harmless state by passage through a municipal sewage treatment plant. Where the city is served by such a treatment plant and a careful study of the waste has shown that it is amenable to the same treatment as the domestic sewage, arrangements may often be made for discharging the waste into the city's sewerage system.

Municipal sewage treatment plants are designed to treat the putrescible organic matter which constitutes the harmful constituent of domestic sewage. Hence, in general, combined treatment of domestic and trade wastes is limited to cases where the trade waste is distinctly of an organic nature, free from acids, grease and floating scum. Where combined treatment is feasible, the arrangements regarding treatment charges are matters of negotiation with the municipal authorities. In the case of a new municipal sewage plant, it is usual for the municipality to charge the manufacturer for a portion of the installed cost of the plant and a portion of the operating cost, including supervision and maintenance.

Partial treatment of the waste at the plant, followed by retreatment of the liquid portion at the municipal sewage works, is frequently employed. The bulk of the heavy, visible solids, which otherwise might overload the municipal plant, is removed at its source by screening and sedimentation, while the proper biologic treatment of the liquid waste is carried out under carefully controlled conditions at the disposal site.

At Cedar Rapids, Iowa, wastes from a packing plant have been handled in this way.

The manufacturer's share of the installed and operating cost may conveniently and equitably be arrived at by computing the ratio of the biochemical oxygen demand for the daily flow of industrial waste to the biochemical oxygen demand of the average daily flow of domestic sewage. Biochemical oxygen demand is a convenient factor for computing the degree of treatment required and from it and the volume of solid and liquid wastes to be treated each day, it is possible to compute the equivalent of the trade waste in question in terms of population contributing domestic sewage. If the city is already provided with a treatment works, additional capacity may have to be provided for the trade waste, in which case the cost of additional units is chargeable to the manufacturer and the total operating cost prorated as before.

Combining trade wastes with municipal sewage is highly advantageous to the manufacturer. He is relieved of the troublesome task of building and operating a treatment works which is different from any of the operations with which he is acquainted. By arranging for the municipality to treat his waste, he does not have direct responsibility and is protected indirectly against such regulatory action as the health authorities may initiate. And, finally, it will be generally a cheaper method of dealing with the situation since both installation and operating cost will be less per unit of capacity in the larger municipal plant.

Frequently manufacturing plants of the same type are situated in the same locality and, where that is the case, the joint building and operation by those manufacturers of a single treatment works may prove both feasible and economical. Such joint efforts are not necessarily restricted to manufacturing plants of the same type. Sometimes two adjoining plants have complementary wastes which, when brought together in the correct proportions, will neutralize each other wholly or partially, thus resulting in the coagulation and precipitation of the wastes with the use of little or no reagents. When this is true, a jointly operated plant may prove far less costly to each party than privately owned plants.

### General Observations

The several examples of industrial waste treatment methods described may be considered as case studies of the subject. They are presented as practical examples of what is being done in these industries, but none of them should be taken as a panacea for all conditions in any one industry or even for all conditions in a given plant. An individual study must be made in each case.

White water, the dilute suspension of fiber in the wash water from paper mills, is a source of stream pollution which may be responsible for the formation of sludge banks, the destruction of aquatic life and the consumption of dissolved oxygen in streams. As pointed out previously in this article, the treatment of white water has, in a number of cases, proved to be that type of industrial waste treatment which actually returns a profit.

The simplest solution, although one that is not always practicable, is to use as much white water as possible directly in the paper machine and to send the remainder back to the pulp mill.

Where direct reuse is not feasible, fiber and filler are recovered and reused in the paper-making process by the use of savealls. Up to several years ago the savealls used in the United States were of the sedimentation or filtration type and in certain mills these have been and still are quite satisfactory. Recently, however, a flotation method embodied in the ADKA saveall has effected unusually high recoveries of fiber and filler from white waters formerly considered difficult to treat. The accompanying phantom view illustrates its method of operation, the path of the white water through the machine being indicated by the line of white arrows. This saveall is in successful operation on white water carrying up to 20 lb. of suspended solids per 1,000 gallons. Clarified effluents contain from 0.05 to 0.5 lb. of solids per 1,000 gallons, depending upon the character of the white water treated. Savings are such that out of nine installations recently investigated, three returned the installed cost in six months, two in 12 months, one in 15 months, two in 18 months and another in 21 months.

The solids contained in packing house wastes are highly odorous and putrescible, being composed of such organic substances as hair, flesh, blood, grease, etc. They cannot be discharged to streams without impairing the potability of the water, destroying fish life and causing disagreeable odors. Furthermore, they seldom can be treated directly in the municipal sewage plant since the grease and paunch manure interfere with the plant operations and the high, organic solid content overtaxes the biologic units designed for the average concentration of domestic sewage.

Treatment of packing house wastes normally consists of (1) Skimming tanks for the removal of grease; (2) Fine screening on rotary drum screens for the removal of large solids, hair, etc.; (3) Addition of lime and alum and mixing; (4) Continuous sedimentation for the removal of fine settleable solids; and (5) Lagooning of the solids on waste land, biological decomposition in digestion tanks or filtration and drying for possible sale as a hog feed admixture.

In most cases the clarified effluent may be sent to the municipal sewage plant or discharged in adjoining water courses without further treatment. Where a higher degree of purification is necessary, the effluent may be chlorinated or subjected to biological treatment, in aeration tanks or trickling filters.

Two successful methods of pretreating large flows of packing house wastes ahead of the municipal sewage plant have been described in technical articles published within the past year. One of these was The Cedar Rapids Combination Wastes Treatment Plant by Howard R. Green, (*Water Works and Sewerage*, July 1937) and the other, Packing House Waste and Sewage Treatment at Sioux Falls, by R. E. Bragstad, and Leland Bradner (*Sewage Works Journal*, November 1937).

The method of treatment at Cedar Rapids is illustrated. The meat packing plant screens its wastes at 60 mesh at the packing house and traps grease on all sewer lines. The screened and grease-free wastes are then sent to a pre-treatment plant and thence to the adjoining municipal sewage plant, both of which are owned and operated by the city.

Green reports that on a combined flow of 7.3 m.g.d., with an average load of 422 B.O.D. the oxygen demand was reduced 85 per cent to an average B.O.D. of 62, with an average removal of 84 per cent of the suspended solids.

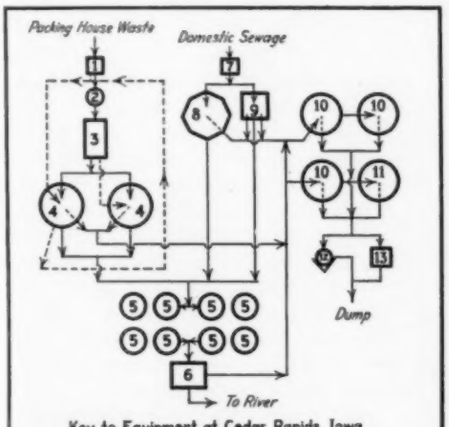
The portion of the plant devoted to pretreatment of the industrial wastes (equipment No. 2, 3, and 4) is flexible in its set-up. It is possible to operate the clarifiers in parallel after flocculation, or in series (dotted lines) so as to obtain clarification of the raw waste in one clarifier before flocculation and in the second clarifier after flocculation.

The Sioux Falls plant is also flexible, provision being made for chemical treatment, trickling filtration, activated sludge treatment and digestion of sludge. Pilot plant studies and full plant-scale experiments preceded design.

The best results have been obtained at Sioux Falls by treating the combined effluent from the primary clarification of the raw domestic sewage and the flocculated packing house waste on trickling filters. A most important step in this plant was careful control in the aeration tanks. To avoid bulking or float it was found neces-

---

Packing house waste

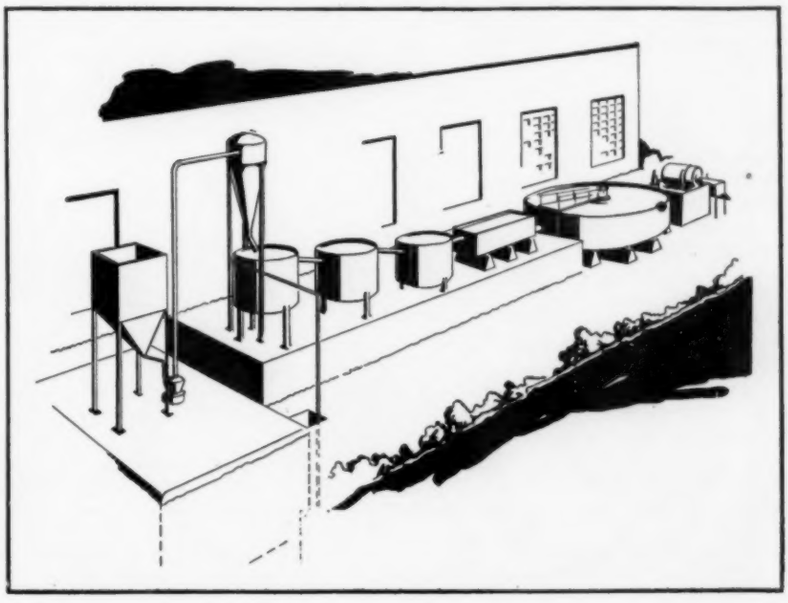



Key to Equipment at Cedar Rapids, Iowa

Equipment at Packing House
1. Fine screen

Equipment at Municipal Sewage Plant
2. Flash mixer
3. Flocculator
4. Clarifiers
5. Rotary distributors
6. Clarifiers
7. Detritor
8. Clarifier
9. Clarifiers
10. Digesters
11. Digester and gas holder
12. Rotary vacuum filter
13. Sand beds

A system for neutralization of pickling liquor



sary to maintain 2.3 p.p.m. of dissolved oxygen in the first half of the aerator and not more than 0.5 p.p.m. in the last half.

The overall removal for the entire plant at Sioux Falls has averaged 98.6 per cent for suspended solids and 98.9 per cent for B.O.D. The final effluent has averaged approximately 10 p.p.m. of B.O.D. and suspended solids.

There are approximately 100 distilleries in the United States, each having an average quantity of 250,000 gallons of slop per day. Some plants have as high as from one to one and one-half million gallons per 24 hours. This is premised on the basis of between 35 and 50 gallons of slop per bushel of grain treated. Several treatment methods for this slop have been proposed and some of them are in use at the present time, but none is entirely successful when all factors, including pollution and costs, are taken into consideration.

The usual and cheapest method is to remove the coarser part of the solids by screens, allowing the thin slop or that part passing through the screen to go to waste at some point of disposal—usually to sewer or river. The quantity of easily recoverable solids varies according to the material and type of treatment. The suspended solids in untreated corn slop may run around 3 per cent and about 2.8 per cent for rye. After screening through 35 to 80 mesh, the suspended solids vary from 1 per cent to 2 per cent and the dissolved solids from 0.5 per cent to 1.5 per cent. The B.O.D. of corn slop may average 16,000 and for rye slop 20,000 to 21,000.

One method of disposal is to recover the waste grain and evaporate the thin slop to syrup and finally dry the syrup to produce a combined cattle feed.

We have worked out a novel flow sheet combining clarification and centrifuging to get the clearest possible liquor to evaporation and the densest sludge to dryers. Experiments with a special trickling filter on various industrial wastes including distillery slop, sugar beet processing, pulp mill wastes and similar effluents are now in progress.●

A process controlled by Sharples Specialties Co. heats the thin slop at elevated temperatures and pressures with or without a small amount of lime. This produces a cracked pulp from which clear effluent and rapid filtering sludges are obtained.

In the preparation of anthracite coal, approximately 1,000 gallons per minute per 1,000 tons raw coal per 7 hours are used at various steps. The usual practice is to send this water with —3/64-in. material and refuse to a thickener for partial clarification to supply water for reuse.

This partially clarified water may be used at practically all of the breaker steps except for the final rinsing of the coal prior to loading on cars, where clear water is required.

Large amounts of two wastes result from steel pickling operations. Both of these wastes are acid-ferrous sulphate liquors, one being the spent pickling liquor and the other the wash water. For years these pickling liquors and wash waters have been discharged to waste but at present most states are forbidding such dumping. Thus the problem for which a number of institutions are now seeking a solution is how to keep the tremendous tonnage of pickling liquor acid and ferrous sulphate from the streams and, if possible, to recover some credits from the treatment.

The methods of treatment now under study may be grouped broadly as follows:

1. *Crystallization of the ferrous sulphate* with one of the following objectives in view.
   (a) Sale or use of the recovered ferrous sulphate.
   (b) Conversion of recovered ferrous sulphate to sulphur and ferric oxide.
   (c) Conversion of ferrous sulphate to sulphuric acid and ferric oxide.

2. *Liming.*
   (a) A neutralization process applicable to both pickling and wash waters with special attention being paid to the production of a fast settling and easily filtered precipitate has been developed. Flocculation, clarification and further dewatering of the thickener underflow are involved.
   (b) The Ferron process provides for treatment of pickling liquor but not for wash water. It consists of treatment with lime in precipitation tanks under controlled pH and temperature, so as to yield a thick slurry. Precipitate is filter-pressed, disintegrated and dried to form Ferron which, it is claimed, is marketable as an insulation and building material.

The recovery of iron oxide and sulphuric acid or sulphur is undoubtedly a logical technical answer to the problem. However, the initial plant cost is considerable and, in addition, the steel companies may be reluctant to enter the chemical manufacturing field.

The Ferron process undoubtedly has advantages for treating pickling liquor but it does not as yet care for the wash waters which, therefore, remain a major problem. If the steel companies will cooperate in the use and sale of Ferron, very possibly quite a tonnage may be produced and sold.

For steel plants requiring an immediate solution to their problem, we believe that neutralization requires the least expensive layout and will prove satisfactory. This treatment with flocculation and clarification, has the advantage of disposing of both the pickling liquor and wash water problems.

Experience has shown that few industrial processing problems present more pitfalls to the uninitiated than the treatment of liquid wastes. Simple as this treatment may seem at first glance, this apparent simplicity has led many a concern to embark, without competent counsel, on a waste treatment project which proved both costly and inadequate. An intimate association with a considerable variety of problems in this category has emphasized the importance of being guided by certain truths of waste treatment which are presented below as a summary.

Most industrial liquid wastes change rapidly with the passage of time and therefore react quite differently after a few days' storage. This is particularly true of those wastes containing organic matter. Hence investigations should be conducted in the field on fresh samples, composited from at least a day's flow. Preliminary studies made at distant laboratories may often indicate the type of treatment required but these should be fully checked in the field before money is expended on a complete installation.

The treatment of an industrial waste is often expensive, running possibly from 10c. to 30c. per 1,000 gallons. Accordingly, the minimum degree of treatment necessary should be determined at the outset.

The operating cost may be high if the treatment plant is a cheap, improvised affair, uneconomical in its use of reagent and dewatering of offensive solids. A more carefully planned, efficient, mechanically operated installation, comparing favorably with the high standards established in domestic sewage treatment, generally pays for its additional cost through reduced operating expense.

All of the above and many other considerations should be duly weighed by competent and experienced consultants in this field. Money spent on such expert counsel will be well repaid generally by a satisfactory solution of the problem.

# Two-Way Protection for Tanks

***It may be good engineering to install dikes to shield expensive tanks from outside damage as well as to provide a safety reservoir for overflow or spillage. Steel fences require less ground space than earthen dikes and are more secure.***

EARTH RETAINING WALLS around oil tanks have been used for many years to control overflow or spillage in case of tank or piping rupture. In the petroleum fields where land is cheap and all outdoors is available for a tank farm, these earth dikes are adequate. But in the more congested quarters of industrial areas the problem is not always so easily solved by the chemical engineer. For such locations something less cumbersome and space filling is often necessary.

In a number of cases concrete or masonry walls have been employed. But more and more during the past ten years steel fire walls have been found advantageous. Construction of this type is likely to increase in importance not only for oil, but for other industrial commodities which might cause significant damage in case of overflow or spillage.

The accompanying illustrations show a variety of types of steel dike construction. In each case the primary objective was to minimize the ground space required. But in each case a secondary and very substantial advantage of protection of the tanks against exterior hazards has also been experienced.

There are a variety of rather obvious advantages in such steel construction:

1. The ground space required for the wall itself is negligible. Oftentimes an earthen dike of gradual slope requires almost as much ground for its base as for the space between the dike and the tank.

2. A steel wall can be made as high as necessary to give the requisite capacity. This greatly reduces the space required between tank and wall, an important factor where free land adjoining is a minimum.

3. A steel wall is tight against water from the outside and is not washed away while new as an earth dike may be in the event of flood.

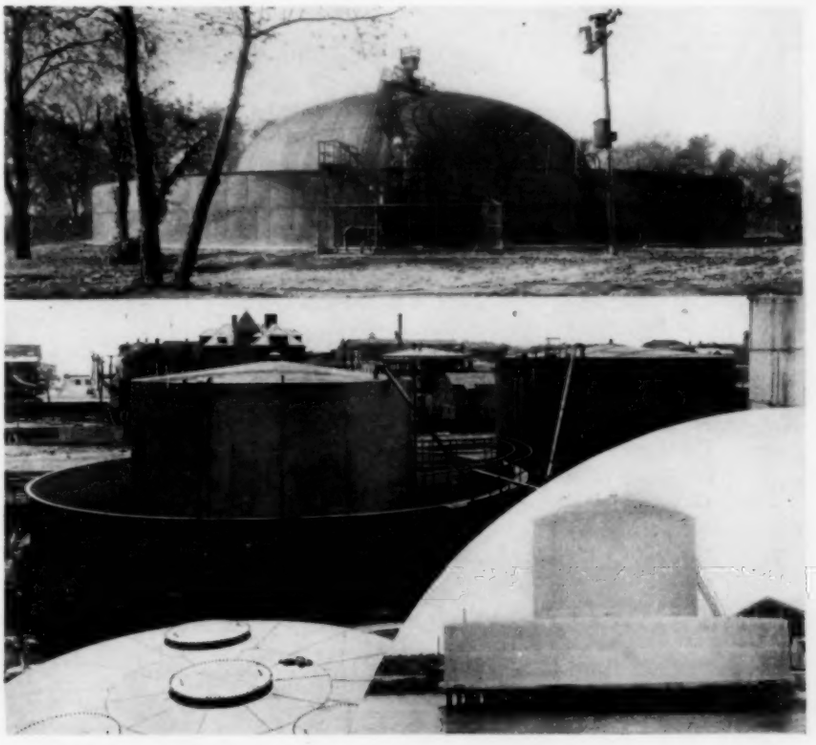
4. Properly designed steel dikes will fend off ice or floating debris and thus afford mechanical protection to the tank proper.

5. The steel wall can be securely anchored into a usually simple inexpensive footing which will protect the tank against the danger of floating under flood conditions. This makes unnecessary, in some cases, the flood anchorage of the tank proper.

Fire insurance requirements often prescribe that fire walls must be used around oil storage units. There are no similar requirements of dike protection for chemical storage tanks, and usually such supplemental protection is not required. But in a few instances it may be good engineering to install dikes both to shield expensive tanks from outside damage and to provide a safety reservoir for the contents of the tank. In the case of refined oil, this reservoir capacity is usually required to be 100 per cent of the tank capacity. But in the case of crude or heavy oils 150 per cent capacity is requisite in order to prevent the oil from boiling over in case of fire.

Engineers having any tank protection and dike problems will do well to consider this modern trend toward steel wall construction either as a complete substitute for earthern dikes or as a supplement to a low earthern dike in order to get greater capacity with limited ground space.

**Top—Wall 12 ft. high, 60 ft. dia., of two rings welded plate on stiffeners spaced at 4 ft. Mounted in concrete base with 3 in. of plate and 15 in. of I beam stiffeners in masonry. Protects 38,600 bbl. gasoline tank in Richmond, Va. Was effective in holding James River when up almost to rim. Bottom—This 20½-ft. fire wall is set in a concrete floor which covers the annular space about the 300,000 gal. oil tank. Inset—This 10,000-bbl. fuel oil unit perches on a concrete slab supported by piles above normal high tide. The steel dike guards against spread of oil to neighboring plants and harbor**



# New Field for Chemical Engineers

*The food industries are becoming aware of their need for food engineering. Fundamentally food processing differs but little from other forms of chemical processing; yet those slight differences are of such importance that a definite supplementary training is required of chemical engineers entering this field.*

LAURENCE V. BURTON
*Editor of Food Industries*
*New York, N. Y.*

THE TERM "food engineering" is proposed for the special application of chemical engineering to the food processing industries. Food engineering involves chemical engineering *plus*. These plus values consist of training in sciences that are intimately related to the properties of foods, such as biological chemistry, bacteriology and sanitation—perhaps also nutrition.

In all his dealings with foods, the engineer must have a working knowledge of the biological origin of his raw materials, their biochemical nature, and he must be acutely aware of the hordes of unseen microscopic forms of life that are constantly and eternally attacking and destroying.

To a chemical engineer whose experience has lain largely in the field of heavy chemicals, paper, gas and coke, paints, ceramics, and the like, there has seldom arisen an occasion when he has encountered the spontaneous spoilage that is nearly always inevitable where foods are processed.

It is important that the food engineer be fully aware of the vast unseen microbiological population with which he must be in daily competition. He must know what the various forms look like, how they grow, what they do, how to shepherd the good ones (for not all microbiological life is unfriendly to man), how to repel them, how to destroy them, how to utilize them, how to grow and cultivate them. In a word, he must know how to master them.

Presented under the title "Adapting the Chemical Engineer to the Food Industries" at the White Sulphur Springs meeting of the American Institute of Chemical Engineers, May, 1938.

In certain branches of the food industry, such as those concerned with fermentation and "curing," it is highly important that the food engineer be armed with knowledge of an obscure and tiny bit of science known as bacterial ecology. This is the science of the relation of microbial life to its environment. Relatively few bacteriologists understand the term or the application of ecological principles to industry, but in my own industrial experience I have found that a knowledge of bacterial ecology has been of great value in taking the guesswork out of some of the ancient arts used in food manufacture.

At this point, it is advisable to state a few definitions. Mankind, and even chemical engineers, are sometimes in doubt as to what constitutes a food. Unhappily, to a large sector of the population a food is only a packaged cereal preparation, originating in Battle Creek, Mich. Even our British contemporaries seem to share the popular American view. On page 83, Vol. 13, of *Transactions of the Institution of Chemical Engineers*, is a tabulation of data on steam generation in which these five categories are given: "confectionery, meat products, bakery, dairy products, *food products*." There is nothing in the text to indicate just what food products really are.

The proper concept of a food is that it is anything to eat (except tobacco) or to drink, up to an alcoholic content of about 22 per cent. This includes the fortified wines such as port and sherry, but excludes the beverages of higher alcoholic content.

We must also distinguish between unprocessed and processed foods. Some forms of treatment—such as spray residue removal, which is the treatment for the removal of toxic substances from the surface of fruits—theoretically leave the food in essentially the same condition as before treatment. The washing and precooling of produce, such as truck crops, is also a form of food processing, though admittedly it is at the extreme outer limit of the concept. Some very recent research experience has shown that some of this treatment preparatory to shipping has resulted in the extinction of the life principle in the produce by drowning and asphyxiation. Fortunately the refrigeration methods employed in subsequent transportation and distribution apparently have been able to compensate for the loss of life principle, and no undue spoilage has resulted. The foregoing affords an excellent opportunity to introduce another need in the basic training of the chemical engineer if he is to be of maximum value in the food industries. This need is a fundamental training in the chemistry of living things—biological chemistry, physiological chemistry, biochemistry, or whatever term is employed to describe it.

What constitutes life is still an unknown subject, though we know a great deal about it. Nevertheless, the life principle (for lack of a more exact term) is one of the greatest preservatives and cheapest preservatives known for organized products of nature. Life

is always dependent on enzymes. Yet enzymes persist after the so-called death takes place. Several important branches of the food industry, i.e., the malting, brewing, baking, cheese-making and confectionery branches, make very important regular use of enzymes in manufacturing operations.

Even today enzymes are little understood. Their composition is unknown. And their activities are not easy to measure with a high degree of accuracy. Yet they are of fundamental importance to most of the food business, whether they be of use as a desired—or added—catalytic agent, or whether their presence in the food raw material constitutes one more unavoidable problem for the food engineer.

By way of illustrating the character of the latter aspect of enzymes, let me cite a problem which I observed in the South in 1930, when the Faulkiner sugar cane harvester was first being tried out. This machine cut the standing sugar cane into pieces about 4 in. long, fanned out the leaves and trash, and deposited the cut cane in a motor truck. The mechanical beating and bruising which the cane received was amazingly severe. In a general way the method may be compared to the combine (harvester-thresher), used in large wheat fields in the Northwest. One of these cane-harvesting machines was calculated to do the work of 200 negroes employed at hand harvesting. It looked like a big economy.

But, at the sugar mill, I found a very perplexed management. The yield of sugar was noticeably lower compared to hand-harvested cane, and the juices had so high an acidity that excessive liming was required for neutralization. This in turn resulted in excessive scale formation in the evaporator, more frequent shut-downs for cleaning. Also there was a lowered capacity of the filter presses, probably due to adhering mud on the cane. The latter problem was due to certain mechanical peculiarities of the harvester.

Without question, a part of the acidity was of bacterial origin, and was not all due to the inclusion of the tops of the cane. I endeavored to explain to the management what I believed to be the cause of the difficulty, and tried to suggest that the economies of the mechanical harvester could be utilized only if the time interval was shortened between the bruising and bacterial infection of the cut cane in the fields and crushing in the mill.

At that plant the time interval was anywhere from 48 to 96 hours, which seemed to be satisfactory where the cane was harvested by hand without bruising. Shortening the time interval to about 2 or 3 hours probably would have obviated much of the high acidity problems and sugar losses, but the plant management did not seem to grasp the idea that enzymatic action set up by bruising was the probable basis of the problem of sugar losses.

### Sanitation Important

Another of the plus requirements in the training of the food engineer is a thorough grounding in the principles of cleanliness and sanitation. The appreciation of this need comes easily after one has had a year of study of bacteriology and learns the difference between a janitor's idea of cleanliness, a chemist's idea of cleanliness and a bacteriologist's idea of cleanliness.

Although all food plants manufacture foods for human consumption, the progress of industry toward the ideal of perfect sanitation has been slow, and in some places, even today, there are certain unsanitary conditions and practices which cause grave concern on the part of regulatory and public health officials.

As a rule, the higher the degree of cleanliness and sanitation, the better the quality of the food, the longer its merchantable life, the better the profits of the manufacturer. But there are exceptions to that rule. For example, in the United States until recently it has been impossible to make good wheel Swiss cheese, for the reason that we did not realize that our operations were conducted in too sanitary a way. Careful research finally revealed that certain bacteria which originate in fresh cow manure were indispensable factors in the creation of the large holes in Swiss cheese which are so highly prized by connoisseurs.

### Why Chemical Engineers?

Summing up the required training for food engineering, we find that it must include chemical engineering plus training in bacteriology, biological chemistry and sanitation.

One of the reasons why I feel so sure that we need a whole new crop of chemical engineers with a plus training in the food industries, is the fact that constantly I find instances where one branch of the industry is struggling to solve problems that have already been solved in other branches. And sometimes the solution is many decades old, and could be had for the asking. Certain sausage manufacturers are trying today to improve their drying operations but cannot quite bring themselves to believe that macaroni drying already embodies the complete solution of the problem.

I have seen a brewer approach a dairyman at the first conference on food technology at Massachusetts Institute of Technology in 1937 and say, "I thought we knew all about oxidation-reduction potentials and their effects on flavor control, but you folks have gone miles beyond us."

Also I have seen a meat packer ask a brewer where he could obtain complete working drawings to build the vaulted ceilings which breweries have used over their fermenting vats from time immemorial. Said he, "We have been fighting ceiling-drip in our curing cellars for forty years, and here you have had the solution all the time."

Examples like these could be extended almost indefinitely, but they all merely indicate the existence of a mental Chinese wall between the various branches of the food business.

The function of the chemical engineer in the food industries of the future will be twofold:

First, by his very training, he will be able to think in principles. He will be able to distinguish the operation from the food on which the operation is performed. He will be able to borrow the ready-made methods from other industries by his trained perception of principles.

Second, he will be able to spot those unit operations and methods that need improvement. He will be able to carry on investigations on the operation, rather than on the foods.

Chemical engineers will be interested in knowing something of the potential market for their services in the food field. In the food industries is found the largest group of industries having a common purpose. The value of foods measured by retail prices is about 12½ billion dollars per year; at f.o.b. factory prices, about 9 billion dollars. This is as big an industry as the chemical process industries. The potential job opportunity is here. The food industries are gradually becoming aware of their need for food engineering. And I hope that as that need becomes more apparent the right men with adequate training will be ready.

# Design For a Phosphate Furnace

***Since 1935* Chem. & Met. *has been presenting articles prepared by chemical engineers of the T.V.A., dealing with the electric furnace process for phosphoric acid, triple superphosphate, phosphorus and metaphosphate. An article in July described phosphate smelting results in detail, while the present article, the last in the series, describes the design of an electric furnace for smelting rock phosphate.***


HARRY A. CURTIS
*and*
ROY C. HEATON
*Tennessee Valley Authority*
*Wilson Dam, Ala.*


IN PAPERS previously published (*Chem. & Met.*, June, 1935, p. 320; Aug., 1936, p. 408; Mar., 1938, p. 116; July, 1938, p. 374) the three electric phosphate smelting furnaces in the T.V.A. Fertilizer Works at Wilson Dam, Ala., have been described briefly and the results obtained therewith recorded. The present paper discusses a number of the items which must be considered in the design of a 5,500 kw. furnace for rock phosphate, and describes in some detail one of the furnaces now in use. (See Figs. 1 and 2, based on actual assembly drawings.)

The designs of the T.V.A. furnaces were in some respects determined by the desirability of utilizing the available electrical equipment originally intended for the carbide furnaces of United States Nitrate Plant No. 2. Somewhat better electrical arrangements could have been made if this limitation had not been imposed.

In phosphate smelting, the electrical energy used serves only to supply the heat required. For a rock phosphate carrying 32 per cent $P_2O_5$ and the additional silica necessary to give the desired lime-silica ratio in the slag, the electrical energy required in the furnaces at Wilson Dam is approximately 5,000 kw.-hr. per ton of $P_2O_5$ in the rock charged.

### Electrical Equipment

*Transformers* — Inasmuch as the current used in the furnace is of high amperage and relatively low voltage, it is desirable to locate the transformers as near to the furnace as convenience will permit. At Wilson Dam, power is delivered to the furnace building as a 12,000-volt, 60-cycle, three-phase current. This current is stepped down in three 2,775-kva. 60-cycle, single-phase, oil-insulated, water-cooled transformers (51) (note: figures refer to numbered parts on Figs. 1 and 2) with taps on the high voltage side which give a nominal voltage from 130 to 190 volts on the low voltage side, in steps of 10 volts each.

The transformers are located in a cell house back of the furnace, below the operating floor. The bus bars (46) from the transformers are interlaced up to a delta connection (45) on the operating floor near the furnace. This arrangement is a part of the old Nitrate Plant and is not a very good one. The transformers might well be located on the operating floor and the bus bars shortened considerably.

From the delta, each of the three phases is carried through 26 flexible 1,500,000-circ.mil cables (42) to a cast copper head (41) from which bus bars lead to an electrode holder. The general arrangement of the electrical connections and the control board is diagrammed in Fig. 3.

*Electrodes*—Either graphite or carbon electrodes may be used. The former will be smaller in diameter for a given power load, because of the high conductivity of graphite as compared with carbon. The graphite electrodes are also smoother and, because of method of manufacture, are more uniformly circular in cross-section. The smaller size, smoothness and uniformity of cross-section are all favorable to maintaining a tight seal around the electrodes at the furnace roof. The advantages do not lie wholly with the graphite electrodes, however. The carbon electrodes are more rugged and the space between the electrode tip and the carbon floor of the furnace, where most of the melting presumably occurs, is larger. The determining factor is, however, the much greater cost of the graphite electrode. At Wilson Dam carbon electrodes are used.

The highest permissible current density in a jointed, carbon electrode for a phosphate smelting furnace is about 25 amp. per square inch under the conditions encountered in the T.V.A. furnaces. With a given power load on the furnace, and a maximum permissible current density, the diameter of the electrode depends, of course, on the voltage. The voltage which can be applied is in turn determined by the spacing of the electrodes, the conductivity of the charge and other factors. Three carbon electrodes, 30 in. in diameter, are used. At 5,500 kw. load, using the nominal 180-volt transformer taps, the furnace will normally draw about 18,800 amp. per phase, with an actual voltage between phases of 192, and a voltage from phase to ground of 110. Under these conditions the current density is about 26.6 amp. per square inch in the electrode of 30 in. diameter.

The electrodes are made up from sections 110 in. long, fastened together by threaded pins. The method of making up electrode joints and the necessity of good electrical contact at the joints have been discussed in ear-

lier papers. The electrode sections weigh about 2 tons each and are handled with a traveling crane. A threaded aluminum plug, having an eye for engaging the crane hook, is screwed into the electrode section to facilitate handling.

Information as to the most effective spacing of electrodes is very meager. Obviously the clearance between electrode surfaces must be sufficient to prevent any considerable passage of current directly from electrode to electrode, for this would heat the furnace charge between electrodes, causing a larger and larger portion of the current to flow directly from one electrode to another. Eventually the pool of slag on the furnace floor would cool and freeze. In Furnace No. 1, the electrodes are set in a row on 5 ft. 9 in. centers. In Furnace No. 2, a furnace of circular cross section, the electrodes are at the corners of a triangle of 5 ft. 9 in. sides. In Furnace No. 3 the electrodes are in a row on 5 ft. 9 in. centers. This spacing has proved to be satisfactory. In Furnace No. 4, which has been constructed but not yet operated, the electrodes are set in a row on 6 ft. 6 in. centers and information will be available later as to the influence of this change.

*Electrode Holders*—Two types of water-cooled electrode holders have been used on the furnaces. One of these, designed by the T.V.A., is made up of four copper castngs hinged together on the sides and bolted together by one large bolt in front and one in the back. Each casting is provided with a lug to which is bolted two copper bus bars. The eight bus bars extend back to a common cast copper head (41) to which 26 flexible copper cables, each of 1,500,000 circ.mil, are fastened by tapered ferrules brazed to the ends of the cables. The ferrules are drawn tight into tapered holes in the cast head by nuts on the ends of the ferrules. The flexible cables extend back to another cast copper head (44) to which they are attached, again by tapered ferrules. The cast copper head (44) is attached to eight bus bars, $\frac{7}{8}$ in. thick by 8 in. wide, these bus bars extending to the delta connection.

The other type of electrode holder used was designed by W. E. Moore & Co., engineers. It consists of eight water-cooled, cast copper pads which are drawn tight against the electrode by means of a heavy austenitic steel (non-magnetic) chain. Current is led to the pads through the copper cooling water pipes.

It is important that the copper used in casting electrode holders be of high

**Figs. 1 and 2—End view and section; and front elevation and half section of T.V.A. electric phosphate smelting furnace**

**Furnace Shell and Lining**

1. Furnace shell
2. Furnace shell buckstays
3. Refractory support angle
4. Base plate
5. Cooling water drain trough
6. Spray piping
7. Tapping spout
8. Tapping spout cooling plates
9. Tapping spout spray guard
10. Firebrick lining
11. Insulating brick
12. Dense carbon blocks
13. Carbon paste joints
14. Sand
15. Gas offtake

**Furnace Roof Assembly**

16. Removable roof
17. Roof binder frame
18. Roof binder cross members
19. Roof binder buckstays
20. Austenitic steel tie rods
21. Non-magnetic C. I. beam connections
22. Water-cooled seal rings
23. Flake asbestos packing
24. Brass water pipes
25. Rubber water hose
26. Cover plate

**Electrode Assembly**

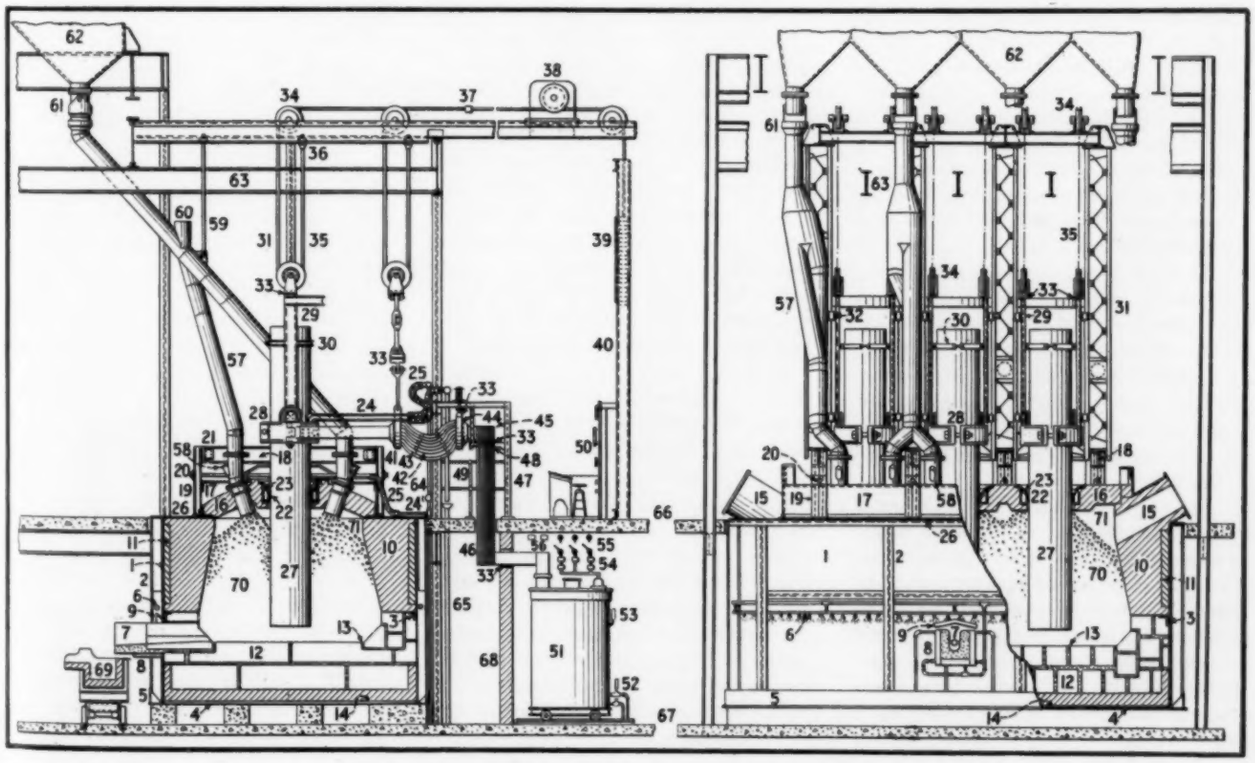
27. 30-in. diameter electrodes
28. Electrode holders
29. Electrode holder support frames
30. Electrode alignment bands
31. Electrode guides
32. Insulated guide brackets
33. Electrical insulators
34. Cable sheaves
35. Plow steel cables
36. Cable take-up terminals
37. Cable eveners
38. Electrode hoisting winches
39. Counterweights
40. Counterweight guides
41. Electrode holder terminal castings
42. Flexible copper cables
43. Cable spacers
44. Cable terminal castings
45. Delta connection
46. Interlaced bus bars
47. Delta support
48. Non-magnetic steel castings
49. Bus bar guard railing
50. Switchboard
51. Transformers
52. Cooling-water piping
53. Thermometers
54. Current transformers
55. Disconnecting switches
56. Potential transformers

**Furnace Feed Assembly**

57. Furnace feed chutes
58. Poke holes
59. Chute supports
60. Chute vents
61. Charge cut-off gates
62. Charge storage bins

**Miscellaneous**

63. Monorails
64. Cooling-water supply piping
65. Cooling-water discharge piping
66. Operating floor
67. Tapping floor
68. Fireproof transformer house
69. Ferrophos trap
70. Furnace charge
71. Gas space



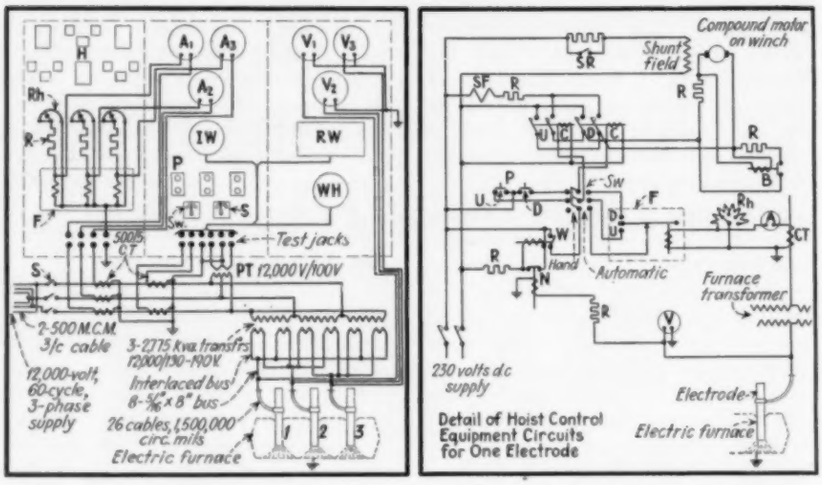
conductivity. Unfortunately, the addition of even small proportions of other metals which facilitate the making of sound castings greatly reduces the conductivity. In writing specifications for electrode castings, it is well to call for use of virgin metal of lake copper ingots, and to specify an alloy containing not less than 98 per cent copper, with a conductivity of not less than 78 per cent that of pure copper. The specification should call for a sound casting, and should prohibit the peening and painting often used to hide defects in the casting.

*Electrode Suspensions*—The current flowing in the electric furnace is regulated by raising and lowering the electrodes, thereby increasing or decreasing the distance from the electrode ends to the carbon floor of the furnace. The arrangement used on the furnaces at Wilson Dam is fairly well shown in Figs. 1 and 2. There is a steel frame (29) extended 7 ft. upward from an electrode holder. At the top of this frame are fastened two 20-in. cable sheaves in housings and adjustable side brackets (32, Fig. 2) which slide on the upright electrode guides (31, Fig. 2). The electrode guides, on each side of the electrode, are electrically grounded at the top and bottom; and the cable sheaves and the brackets mentioned electrically insulated from the holder frame.

The steel frame, carrying the electrode holder, electrode, etc., is suspended on steel cables (35). The cables for each electrode, together with the cable which suspends the cast copper head (41), join a single horizontal cable through an evener (37). The horizontal cable is wrapped twice around the 12-in. friction drum of a winch (38), then passes over another sheave and is attached to a counterweight (39) of 6,000 lb.

There is a separate winch for each electrode, operated by a shunt or compound wound d.-c. motor on 230 volts. These motors are under either automatic or manual control from the control panel. The automatic control mechanism is operated by variations in the a.-c. current passing to the electrode.

The operating speed of the winches is normally such as will raise or lower an electrode at a rate of 8 in. per minute. There are switches provided, however, to cut resistance into the shunt field of the winch motor so as to give up to three times the normal speed when desired as, for instance, when moving the electrode clamp up to a new position on the electrode.




**Figs. 3 and 4—Electrical connections for control and metering, with switchboard and transformer connections at left and detailed electrode hoist control equipment circuits at right**

A. Ammeter
B. Magnetic brake closing coil
C. Switch closing coil
CT. Current transformer
D. Down
F. Contact-making ammeter
H. Electrode hoist control equipment
IW. Indicating wattmeter
N. Undervoltage relay
P. Pushbutton switch
PT. Potential transformer
R. Resistor
Rh. Rheostat
RW. Recording wattmeter
S. Circuit breaker control switch
SF. Series field
SR. Speed regulating switch
Sw. Hand or automatic switch
U. Up
V. Voltmeter
W. Auxiliary relay
WH. Watthour meter

If shunt wound motors are used on the winches, they must be built for the service. A standard shunt wound motor will not be stable and will arc at the brushes when the field is reduced to give three times the normal speed. Compound wound motors start and stop somewhat more smoothly, but they require that the series field leads be brought down to the switch board in order not to be reversed when the armature circuit is reversed.

In designing the cable suspension system, it must be borne in mind that the whole mechanism is in very frequent operation throughout the 24 hours of every day the furnace is in use. The actual consumption at the lower end of the electrode on a 5,500-kw. furnace is only some 5 or 6 in. per day, but each electrode must be raised or lowered every few minutes due to changing resistance in the much disturbed region between the lower end of the electrode and the furnace floor.

*Bus Bars*—The size and number of bus bars for an installation of assumed current and voltage may be chosen with reference to the standard sections available. In any event the cross-section should be such that 1 sq.in. of copper bus is provided for each 1,000 amp. of current.

The bars should be sufficiently stiff and supported so that they will not move appreciably due to either mechanical or electrical stress in service. The bars should be interlaced from each transformer to the delta, and the delta should be as near the furnace as is practical in order to minimize impedance. It is desirable to mount the bus bar on edge so as to minimize collection of dust and to secure a maximum of air movement past the surfaces of the bars.

Where the bus bars and flexible leads are all of the same polarity at any instant, as is the case between the delta and an electrode holder, the leads should be held apart by a suitable spacer so that each lead will carry approximately its share of the total current. The flexible leads actually in use on the furnace are 26 in number, of 1,500,000 circ.mil each, spaced around a 20-in. circle. The bus bar spacers may be of slate or hard asbestos board, or any non-shrinking, non-combustible insulating material. Supporting structures close to the bus bars or looping around them should be of non-magnetic material. Cast iron containing 3 per cent C (approx.); and Si, 1.5; Mn, 1.20; Cr, 2.00; S, 0.10 max; P, 0.20; Ni, 14.00 min.; and Cu, 6.00 per cent min., is relatively non-magnetic and is machinable. Castings of this composition may be used for the coolers around the electrodes at the furnace roof.

Of the non-magnetic steels, there are two general types that will be found useful. One of these, carrying not less than 12 per cent manganese, is satisfactory where no drilling or machining is necessary. Of the chrome-nickel steels a satisfactory one contains C, 0.16; Mn, 1.00; Si, 2.00; P, 0.03; S, 0.03; Cr, 16.5-20.0; and Ni, 7.0–10.5 per cent. Chrome-nickel steel of this composition costs about three times as much as the manganese steel mentioned.

### Electrical Control

The general arrangement of the electrical connections for control and metering at a furnace is shown in Figs. 3 and 4. The electrical metering, except the secondary voltages, is all through current transformers and potential transformers on the high tension side of the three main transformers. The three main ammeters on the control panel (calibrated to show current in the individual electrodes) are connected in series with three so-called contact-making ammeters. These contact ammeters serve as a.-c. relays controlling the switches through which current passes to the winch motors in the electrode suspension system. Each contact-making ammeter is connected in parallel with a variable rheostat, so that by cutting in more resistance a larger proportion of the current is sent through the contact ammeter coil, thus making it operate at a lower load on the particular electrode with which it is connected.

For control purposes, the regulation of the voltage between each electrode and the furnace floor, by lowering or raising the electrodes, offers a means of keeping the power dissipation by the electrodes balanced. It will be found in practice that a better electrical balance may often be found by interchanging the connections on the high tension lines, inasmuch as the reactions in the high tension lines, in the transformers, etc., enter into the determination of the electrical balance at the delta. With three lines there are six combinations possible, and the one giving nearest equal voltage to ground for equal current per electrode may be found by trial.

### Furnace Construction

One furnace of circular horizontal cross-section and three furnaces of rectangular horizontal cross-section have now been built at Wilson Dam. The advantages and disadvantages of the two shapes have been discussed in earlier papers.

The spacing and size of the electrodes having been decided, the inside horizontal dimensions of the furnace will be fixed by the clearance desired between the electrodes and the furnace walls. There appears to be no guide other than experience in fixing this clearance. Obviously it must be enough to permit the furnace charge to settle down around the electrode as melting of the charge occurs near the floor of the furnace. The hottest zones in the furnace are immediately under the electrodes and it is desirable to have the furnace walls as far away from these very hot zones as other conditions will permit. The pool of molten slag on the floor of the furnace carries heat to the furnace walls, and there is a slow chemical reaction between the slag and the carbon lining, both at the walls and on the furnace floor. This chemical corrosion is most severe under the electrodes and once a year the carbon lining of the furnace must be renewed below the slag level. Hence, there is no occasion to move the furnace walls far enough back from the electrodes to give the carbon lining of the walls a life appreciably longer than that of the furnace floor.

In Furnace No. 1 at Wilson Dam, the electrodes are in a row on 5 ft. 9 in. centers, with a clearance of 3 ft. 3½ in. between the electrodes and the carbon lined end walls and a clearance of 4 ft. 2 in. from electrodes to side walls, giving a furnace 20 ft. 7 in. long by 11 ft. wide at maximum inside dimensions. Furnace No. 2 is of circular horizontal cross section, with electrode centers on a circle of 39$\frac{11}{32}$ in. radius. The clearance around electrodes is 37$\frac{5}{32}$ in., giving an inside furnace diameter of 15 ft. 4 in. near floor level. In Furnace No. 3 the electrodes are in a row on 5 ft. 9 in. centers, with a clearance of 4 ft. from electrodes to end walls and a clearance of 4 ft. 5½ in. from electrodes to side walls, giving a furnace 22 ft. long by 11 ft. 5 in. wide at maximum inside dimensions. In Furnace No. 4 (built but not yet operated) the electrodes are in a row on 6 ft. 6 in. centers, with a clearance of 4 ft. from electrodes to end walls and a clearance of 5 ft. from electrodes to side walls, giving inside dimensions near the furnace floor of 23 ft. 6 in. by 12 ft. 6 in.

*Furnace Supports*—In some instances phosphate smelting furnaces have been designed to rest in a pan of water so as to keep the steel bottom of the furnace cool. This we regard as a dangerous arrangement, for if at any time the refractory of the furnace floor is corroded through, so as to allow molten ferrophosphorus to contact the steel, the latter will be alloyed and fused immediately, allowing molten ferrophosphorus to pour into the water pan, thereby generating steam with explosive violence.

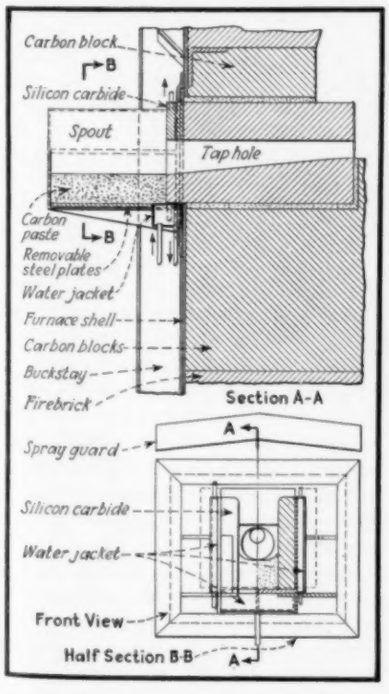
The furnaces at Wilson Dam are supported on concrete piers about 20 in. high. The height of the piers is, of course, determined by the elevation desired at the furnace tap hole. A floor of heavy cast iron plates is laid on the piers and the steel bottom of the furnace rests on the cast iron floor.

The total weight of the empty furnace resting on the piers is about 244 tons and the approximate weight of the charge is 50 tons.

*Furnace Shell*—In view of the fact that elemental phosphorus is produced and vaporized in the furnace, it is desirable that the furnace be as tight as possible against leakage of air into the furnace or leakage of furnace gases out of the furnaces. Commonly the furnace below the roof is inclosed in a steel shell. The shells of the furnaces at Wilson Dam are built of ⅝-in. steel plate, with welded joints.

The furnace of circular horizontal cross-section requires no bracing, but the rectangular furnaces are braced externally with 8-in. I-beams. The

Fig. 5—Furnace tapping spout



steel bottom of the furnace is extended 8 in. beyond the vertical walls and the I-beams are anchored to the furnace bottom at their lower ends. The upper ends of the I-beams are anchored to a horizontal plate girder which extends over and protects the top of the brick furnace lining. A trough to collect the cooling water used on the shell is provided as shown (5) in Figs. 1 and 2.

*Furnace Lining*—Above the slag level in the furnace there is almost no corrosion and any refractory brick lining will last indefinitely. Below the slag line the furnace must be lined with carbon, preferably backed by brick. The reason for the carbon lining is twofold. In the first place, the carbon floor of the furnace serves as a conductor in the electrical circuit. And secondly, carbon resists the corrosive action of molten slag better than most other refractories. A carbon furnace lining 24 in. thick in a water-cooled shell will last about a year. The furnace lining must be designed so as to permit annual renewal of the carbon lining without disturbing the brick lining above the slag line.

One of the actual arrangements used in the Wilson Dam furnaces is the following. A layer of clean sand about 2½ in. thick is spread on the steel bottom of the furnace. Four courses of firebrick are then laid down on the sand, giving a brick floor about 10½ in. thick. A brick lining 4½ in. thick is extended up the inside steel walls of the furnace to a height of 16 in. above the brick floor. Two courses of carbon blocks, each 16 in. thick, are then laid down on the brick floor, and a carbon lining 24 in. thick carried up the steel walls to a point 66 in. above the steel bottom. Above the carbon lining, the shell is lined with a superduty firebrick wall 9⅛ in. high and 24 in. thick. Ordinary firebrick are used to build the lining above the superduty brick.

In constructing the carbon lining, the first course of blocks is laid with 1-in. wooden spacers between blocks. A hot carbon paste is then rammed into the space between blocks. The second course of carbon blocks with rammed joints is laid over the first, setting the blocks in a layer of hot carbon paste about ¾-in. thick.

As indicated above, the carbon lining is carried up the side walls of the furnace to a level well above the highest level reached by the surface of the slag pool. It is well to have an 8x8x¾-in. angle iron welded around the inside of the furnace shell at the top of the carbon lining, the horizontal leg of the angle serving to support the brick lining above the carbon wall when the latter is removed during the annual repair or replacement of the carbon blocks.

*Tap Hole*—The furnace tap hole must be carefully designed and constructed if it is not to be a frequent cause of difficulty. In Fig. 5, the general design of a satisfactory tap hole is shown. Inside the furnace the tap hole is cut through a carbon block which forms a part of the furnace lining. This block may be withdrawn and renewed without more than a temporary interruption of furnace operation. The carbon block extends outward a short distance beyond the furnace shell. The tap hole outside the furnace is carried in a steel trough which is welded to the furnace shell. The sides of this trough are water-cooled. The floor of the trough is water-cooled in the end next the furnace. The trough is lined on the sides with silicon carbide brick and on the bottom with a carbon paste-clay mixture for easy patching. Several months service is had before the trough must be given a general repair.

*Furnace Roof*—It is highly desirable that the furnace roof be removable, from the standpoint of both convenience and safety. When the furnace is shut down for relining below the slag line the roof may be removed and the job of cleaning out the furnace begun without waiting for the charge to cool completely. The new blocks for relining may be lowered into place with a crane, thus saving time. And the open furnace offers safer working conditions for the man on the relining job.

The furnace roof should be an arch of high-heat-duty firebrick shapes about 13 in. thick, with rings about 18 in. thick to receive the electrodes. The thrust of the arch is taken up in a frame around the roof. For the circular roof, the frame may be a 20x¾-in. channel bent into a circle, with lugs welded onto the frame to facilitate attaching to the crane for lifting. The rectangular furnace roof requires a somewhat more elaborate frame, such as shown in Fig. 1. A furnace roof will last indefinitely under normal operating conditions.

*Gas Offtake*—It is desirable to have the leg of the offtake nearest the furnace as short as possible and to have it slope back into the furnace above the normal level of the furnace charge. Provision must be made for cleaning the offtake without interrupting the furnace operation. It is convenient to make a right-angle turn in the offtake as near the furnace as possible. This permits the use of a scraper cleaner in the short leg of the offtake next the furnace, the handle of the scraper being brought out through a gas-tight stuffing box. Material collecting in the short leg is pushed back into the furnace.

*Electrode Seal Rings*—The difficulty of keeping the furnace reasonably gas tight is greatest where the electrodes pass through the furnace roof. An electrode 30 in. in diameter requires a packing gland about 8 ft. mean circumference. The ordinary carbon electrode is by no means smooth and the diameter will vary a little. In operation the rise and fall of the electrode may be as much as 20 in. It will be seen that the problem of keeping a gas tight seal around the electrode is most difficult. Many schemes have been tried but all really gas-tight seals have failed. The arrangement shown in Figs. 1 and 2 is the best developed to date. In this a water-cooled, non-magnetic metal casting (22) surrounds the electrode. Loose asbestos is then piled around the electrode in the space (23) above the water-cooled ring. The furnace operators tamp the loose asbestos into place frequently as it becomes displaced by the rise and fall of the electrode.

*Feed Chutes*—The arrangement of feed chutes for the furnace offers some difficulties. The charge in the furnace must be as uniformly distributed as possible and the furnace should at all times be filled nearly to the roof, leaving room only for free flow of gas to the gas offtake. In the furnace shown in Figs. 1 and 2, the charge is fed into the furnace at 12 places.

The chutes make a gas-tight connection with the furnace, as shown in Fig. 1. Each chute is provided with a poke hole (58) near the furnace, and at the joint just above the poke hole the lower end of the chute is electrically insulated from the upper lengths. Cut off gates are provided at the upper ends of the chutes (61) and a vent provided (60) to obviate the danger of gas from the furnace backing up into the feed bins (62) and there forming an explosive gas mixture.

Vertically the chutes must be so arranged that the electrode sections may be brought over the furnace by the crane which runs on the I-beams shown (63, Fig. 2).

# PUBLIC RELATIONS *for* INDUSTRY

***A presentation of the imperative need of mutual understanding in the conduct of our daily work***

**with special reference to**

**CHEMICAL PROCESS INDUSTRIES**

*Presented by* CHEMICAL & METALLURGICAL ENGINEERING
A McGRAW-HILL PUBLICATION

AN EDITORIAL SERVICE TO MEET

# INDUSTRY'S MAJOR PROBLEM

*To the readers of Chemical & Metallurgical Engineering*

THERE IS NO DOUBT that today the American people are taking a keener, more critical interest in the conduct of business than ever before. And when I say critical, I mean exactly that. During recent years most of them have suffered loss, either of jobs or of savings, and under such circumstances men are prone to accept without serious question any scapegoat that appears plausible. In the confusion of fears and resentments, they seem to have concluded that short sighted and selfish business management is chiefly responsible for their misfortune.

However mistaken and unfair such conclusions may be, management cannot ignore them. It must recognize that in the long run, the opinions of men are the result of experience, of what happens to them each day, much more than of what they are told.

Progressive management has already faced that fact; has already begun to think and work beyond the technicalities of production and distribution that once absorbed most of its energies. It sees more clearly and deals more proficiently with its human responsibilities. It is learning to reconcile the economic success of the industrial unit with the social welfare of worker and community.

Presently, every business—the small retailer as well as the large manufacturer—must learn how to interpret more convincingly to its own public the social as well as the economic benefits of its policies and accomplishments. Only as each business satisfies the newly aroused and critical interest of people in its affairs will it be able to disarm those who trade on the human tendency to blame our troubles on someone else. Yes, if business as a whole is to win a favorable public opinion, each and every business must act to improve its own public relations.

The readers of this journal, and of other business publications, compose, we believe, a group that can achieve for American business a sound and lasting solution of this vital problem. They alone are in position to shape the working conditions of 21 million employees. They alone can mould the attitude of those other millions who compose the various "publics" to which all business must be responsible.

Heretofore, the function of business papers has been to exchange successful experience; to dig up and disseminate practical facts for the use of their readers, serving primarily the technical and merchandising needs of business. But this matter of human relations has now become of equal importance, for good industrial and public relations, it has been found, reduces corporate losses, removes fear and suspicion, promotes operating efficiencies in both production and sales. A better knowledge of public relations technique is, therefore, quite properly essential for men in, or moving into, positions of greater executive responsibility.

So, beginning with this insert, each McGraw-Hill publication sets out to strengthen its editorial service in the important domain of Public Relations. I hope that the million readers of McGraw-Hill's business papers will get much real and practical help toward building better relationships between their own businesses and their employees, their customers, and the communities in which they must carry on.

James H. McGraw Jr.

President, McGraw-Hill Publishing Co., Inc.

# *Why a*
# Public Relations Program

IN LESS THAN TWO GENERATIONS the United States has changed from an agricultural to an industrial nation. Living standards and efficiencies at once the despair and envy of other countries have been created. Foreign delegations still flock to our shores to study our methods so that they may use them as patterns for their own organizations. Yet here at home today these methods and the systems responsible for them are under increasing attack.

Since every person employed in productive enterprise is a part of American industry, these attacks imperil the livelihood of nearly forty million workers and their dependents. The newest addition to the payroll has as much—if not more—at stake as the veteran business executive. That also is true of particular industries which at present may not be under direct fire. All industry is so interrelated and interdependent that even the seemingly immune enterprises must suffer when the legitimate activities and the buying power of their customers, or the customers of their customers, are curtailed.

Ironically enough, public acquiescence in many of the current attacks is an indirect recognition of the satisfactory manner in which our industrial system normally functions. Reasonable opportunities for the employment of those ambitious to put their mental or physical talents to work, and continually rising standards of living have come to be widely accepted as a matter of course. Any unfavorable change in these conditions leaves the general public surprised, confused and resentful. Such reactions as these make it easy for pressure groups to unloose destructive propaganda which further heightens resentments and breeds new misconceptions.

These misconceptions take many forms shaped by the experience, the inexperience, or the special interests of the critics. To one it appears that business can't manage itself and must be owned and managed by the Government. Another believes that employees are underpaid or that stockholders and executives are overpaid. To others corporate surpluses are too high. Many have convinced themselves that power and machines have reduced employment opportunities; and that industry can raise wages and reduce prices while costs go up.

Several misconceptions are based on faulty generalizations. Because a few companies have been remarkably successful, it is argued that all could make money. Because some corporations have been ruthless, all corporations, it is contended, will stoop to unethical conduct to gain their ends. This is like saying: John Smith killed Bill Brown; John Smith is auburn-thatched; all redheads, therefore, are murderers. Unfortunately, those who would indict all business for the crimes of a few are more subtle in their approach and so create an impression not in accord with the facts.

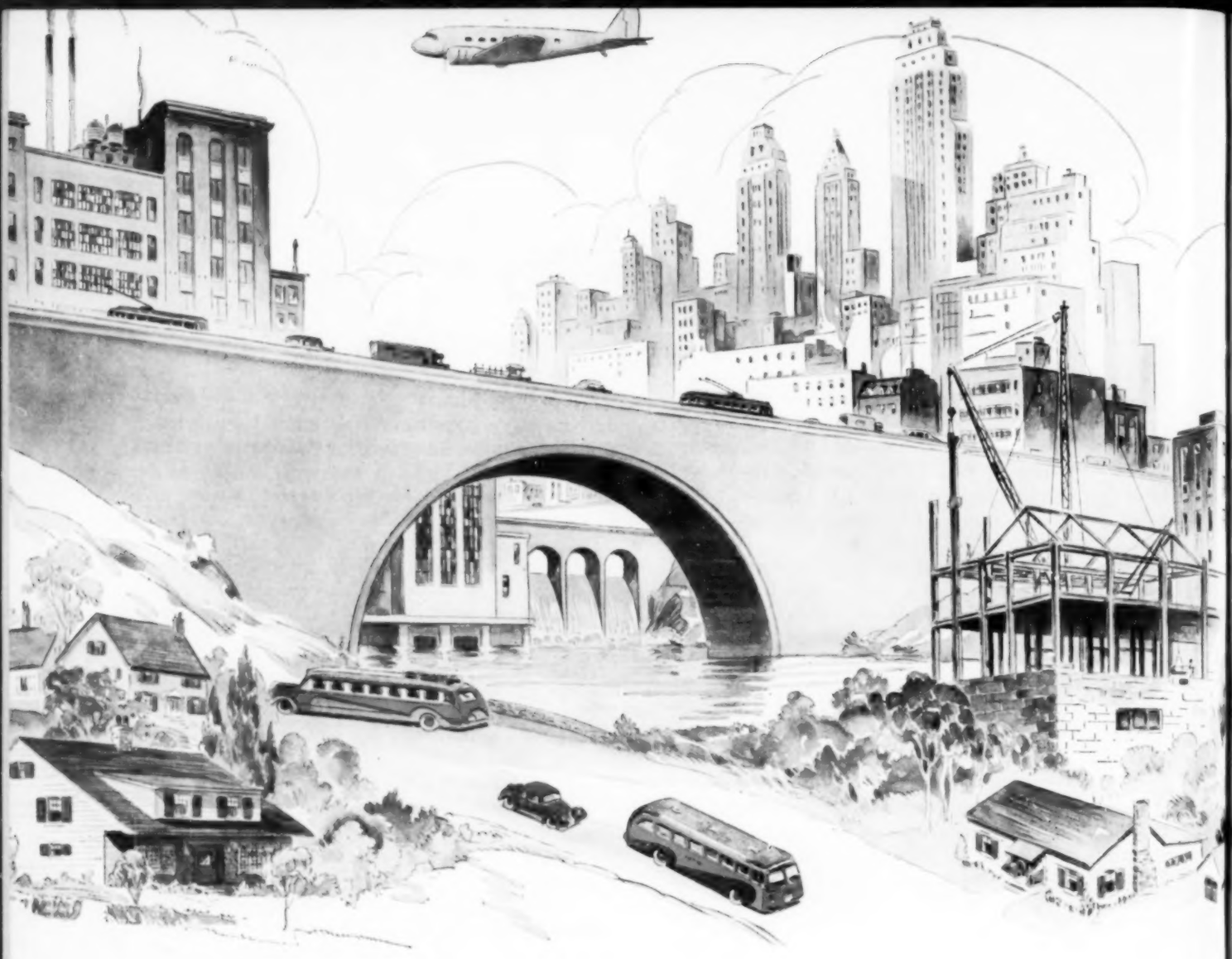
To put it bluntly, American industry, once so highly praised for its contributions to the national well-being, is now on the spot. Prevailing misconceptions of how business operates and what it does have made a field day for those who propose to hamstring or destroy private initiative and individual opportunity. These proposals run a broad gamut: They include public ownership, increasing and rigid federal control at the expense of local autonomy, ill-conceived legislation on hours and wages, labor dictatorships, and confiscatory taxes on thrift and employment security.

While the man in the street may be criticized for his willingness to swallow these nostrums, he is not wholly to blame. Industry, too, has been at fault, in assuming either that he was fully informed on those phases of its operations which are properly a matter of public interest, or that a healthy curiosity should be discouraged. Misconceptions multiply where the facts are hidden.

The tragedy of the situation lies in the fact that it might easily have been avoided. In the simple days of local and localized industry, everybody connected with a particular enterprise knew everybody else connected with it, and the details of its operations were an open book. The boss and the employees were neighbors; the customers, for the most part, fellow townsmen. Outside purchases were limited largely to those products which the local community neither manufactured nor raised. Competition in the modern sense was practically nonexistent.

As industry developed and enlarged its field of operations, much of this early intimate personal touch was lost. The small enterprise grew bigger. In some cases combinations took in the local business and financial control passed out of the community. The local industry which still retained its identity was busy meeting increased competition and seeking to expand its distribution. Little attention was paid to changing conditions that were fostering misconceptions about the personal relations of the business. Bit by bit the close acquaintance and familiarity of the early days disappeared.

Common understanding of these things also was impeded by the greater variety of occupations as industry expanded. Each man's job became so highly specialized that the old feeling of common partnership in a joint undertaking frequently was buried in an exaggerated feeling of the relative importance of his own work. This made it easy for each occupational group to get the idea that its contribution to the undertaking



alone was essential and that many of the other groups were parasitic or, at best, unimportant.

Such mistaken beliefs are the exclusive property of no particular group. "Goods are valueless until sold," chants the sales staff; "without us the wheels of industry would cease to turn." The wheels would turn much faster, growls the production department, "if we didn't have so many lame-brains drawing fat salaries as salesmen." Under the cold glance of both groups, the clerical force heatedly inquires: "How long do you think this business would last if we didn't keep the cost records, send out bills and collect the money for pay checks?" Some executives and engineers, too, have been known to forget that their plans cannot be carried out without the cooperation of other groups.

Possibly the greatest single cause of misunderstanding and friction has been fuzzy thinking on social responsibilities. Many of the responsibilities which rested on the individual or the state in our fathers' and grandfathers' days have been shifted to the shoulders of industry. New ones constantly are added or proposed—often before industry has had time to adjust itself to those which have gone before. Some of these responsibilities affect employee relations; others involve customer relations. The worker, for example, no longer is completely defenseless against the occupational hazards of his employment. "Let the buyer beware" no longer is considered smart merchandising. Many of the changes now embodied in the laws were anticipated by industry itself. Opposition—valid or otherwise—to social legislation, however, has been used to damn business in the public eye.

Fortunately, the barriers to good will and common understanding can be broken down. The process is a simple one. It consists chiefly in maintaining good policies in human relationships and in keeping all interested people—employees, stockholders and their neighbors, customers and the general public—informed. It means telling them in plain terms what revenue is received and where it comes from, what revenue is paid out and who gets it, how an industry serves the individual, the community and other industries. Finally, it includes the acceptance of the social responsibilities which the advance of civilization imposes upon business.

Add all these things together and you have public relations.

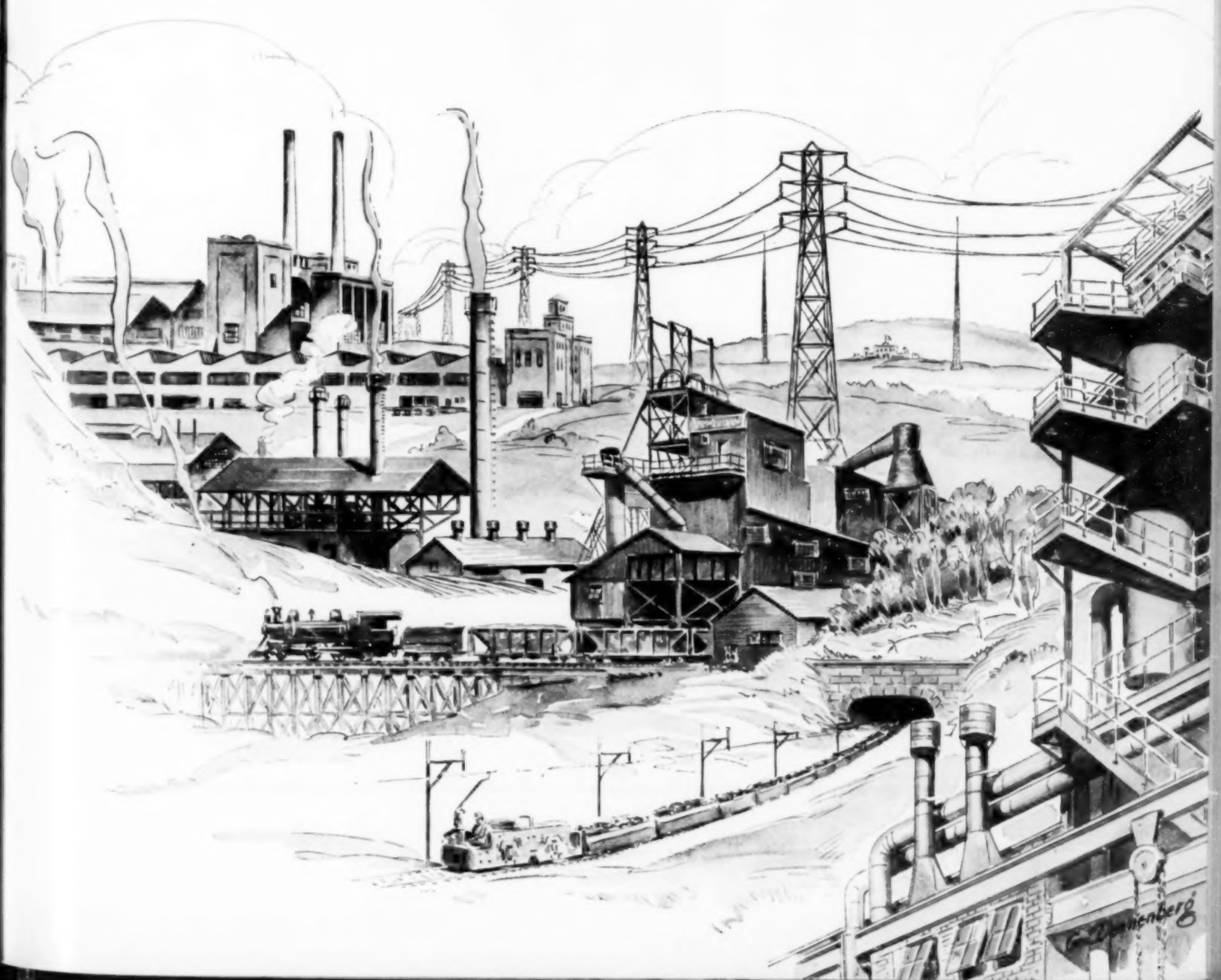
Most employers are willing to accept their social responsibilities, but they are inexpert in making that acceptance articulate. Too many employers have failed to make clear their policies, their practices and their purposes as they relate to fair dealing with employees, investors and the general public. Their intentions have been good, but they have cloaked them with a veil of secrecy and made a mystery out of simplicity. As a result the uninformed have been given a royal opportunity to exercise their imagination. And they have done it!

Public relations is a comparatively new activity for most business enterprises and involves a technique which too many have not yet learned. Obviously, the first place for each company to start is within its own organization. This is the "inside job" that builds a company's good name among its own family and lays the firm foundation for building public confidence and favor. As one exponent of the art phrases it: "Industry's public relations cannot be one thing and its private actions and policies something else. The two must be in complete accord."

The inside job should present no real difficulties to fair-minded employers. Most workers have a normal predisposition to view in a favorable light the organization in which they earn their livelihood. Most companies endeavor to conduct their operations so as to justify that favorable attitude. But too few of them are adept at dramatizing the facts that furnish a substantial basis for maintaining employee good will. So, where misunderstanding and suspicion born of ignorance exist, time may be required to break down the barriers that have grown up.

The task of telling this inside job to the outside world, however, will not be easy, for two reasons. First, it has been so long neglected that the backlog of misunderstanding is large. Second, public relations involves attitudes as well as actions, a viewpoint as well as an organization. Public relations is not a commodity that can be purchased like a car of coal or a bolt of silk; neither can it be sold by "canned" material. Each program to establish sound public relations must be individualized and indisputably stamped with the personality of the company promoting it. *And the deed must always back the word!*

But the task is worth the effort. For, with the inside job right, a properly conceived and intelligently executed public relations program offers business the means of successfully counteracting unjust public suspicion, unfair political attack and unwarranted outside dictation. The need is urgent.



# A Public Relations Program For the Chemical Process Industries

BECAUSE the products of most chemical plants are not sold directly to the ultimate consumer, there is often the mistaken idea that the affairs of the process industries are not matters of widespread public interest. Sometimes there has been a tendency to withhold information about a company's payroll and number of employees, or about its technical developments and achievements, largely in the belief that it would be misunderstood and misinterpreted. Yet today many companies are beginning to realize that "the extent to which the public is informed regarding these activities determines, in the long run, the public's attitude toward a company and toward industry as a whole." (See Chaplin Tyler's "Chemical Engineering Economics," Second Edition, p. 229, McGraw-Hill, 1938).

There is an increasing need for people who can interpret industry to the public. It requires a highly specialized technique. A capable man may be available within the organization but the job is not one for an amateur. In the majority of cases some help must be sought from the outside—either by hiring an experienced industrial relations executive, or by retaining a management consultant with a good record of achievement. It is absolutely vital, of course, that the executives of the company be solidly behind any public relations program—recognizing it as a permanent function of management.

Once a company has decided to develop and improve its technique of public relations, it is possible to lay down and follow out a simple, definite program. The basic elements are nearly identical whether it be for a chemical company, a petroleum refinery, a pulp and paper mill, or a fertilizer factory. The problem resolves itself into an "inside" job and an "outside" job.

It must start with the building of greater good will among a company's own employees and radiate from and through them to all the elements of the plant community, ultimately to reach the customers and other interested groups of the general public.

Six fundamental steps in the development of good industrial relations within the organization are briefly listed on the opposite page. These steps are designed to create and maintain on the part of employees a feeling of confidence in the management and satisfaction with their work and their future. This is the most important part of the "inside job" of public relations. Not only is it necessary to *do* the inside job,—it is equally essential to let employees know it is being done.

Having done a good job on industrial relations within the organization, the most important step has been taken toward building up good will on the outside. The company is now in a position to tell its customers and the public not what it aspires or pretends to be, but what it actually is and how it is contributing to public welfare.

### *Significant Quotations*

**"Fundamentally, good public relations consist in being a good neighbor in the community in which the company finds itself. * * * But no industry can expect the good will of its immediate neighbors until it has the good will of its employees." —Frederick G. Hughes, General Manager, New Departure Division, General Motors.**

* * *

**"The Public must be told the truth about business, even though it involves divulging information that in the past has been considered sacred property to be withheld from others at all costs."—James W. Hook, President, New England Council.**

In the community where the company is located, people judge it by the things they are told. They may get their information from individuals or groups who are not part of the organization and are working for selfish ends. They may or may not give the facts. Or, inquirers may get their information from the employees themselves, who are prone to tell the truth as they know it. In promoting good will in the plant community, well-informed employees are an invaluable asset to any company.

A company can participate actively in building good will in the community by taking progressive steps to publicize the facts about itself, making them available promptly, accurately, clearly and frankly, through the usual media that exist in every community. A related method is the taking of an active and constructive part in community affairs. By becoming itself a good citizen and neighbor, a company makes itself known and liked.

Building and maintaining the good will of its customers and consumer groups is an obvious function that most chemical process industries have not neglected. Yet there are many examples where companies have failed to publicize their activities in a way that will arouse and hold the interest of its specialized public. Some have failed to accept their full share in the educational responsibilities of the industry as a whole. They have left to others the active and aggressive participation in trade association and related industrial activities—failing to realize that the individual company is likely to benefit most if it contributes willingly and fully.

The various steps in a working program for improving public relations for the process industries can be given here only in the barest outline. But it is important to emphasize that something more than specific methods and technique are required. A company can perfect the routine procedure of getting publicity and can participate in worthwhile activities of its community and industry, *without* gaining public acceptance if its policies are wrong or its words belie its deeds. It is vitally important, therefore, that constructive public relations must permeate and dominate every attitude and action of a company.

# Steps in a Working Program

*To Improve Relations*

## WITH EMPLOYEES

1. Set up an able leader — an executive skilled in guiding human relations.
2. Clarify organization through definition of authority and responsibility in the functions of all officials.
3. Determine sound personnel policies and when adopted, see that they are known to all employees. They should be definite as to wages, hours, overtime, promotion, lay-offs, vacations, sickness relief, safety, training and education, profit-sharing, collective bargaining.
4. Improve personnel efficiencies through proper wage incentives; pay prevailing wage and salary scales, evaluate jobs, establish pay differentials and set up positive procedures for promotion.
5. Assure the well-being of employees by providing safe and sanitary working conditions and, if possible, establish organized protection against unemployment, sickness, old age and death.
6. Train and educate through a suitable program for advancing men and women in the organization, and as citizens of the community.

## WITH PLANT COMMUNITY

1. Keep community thoroughly informed about the number of people employed, wages and hours, policies in reference to sickness and accident relief, lay-offs, vacations. Show dollars spent in community for payrolls, taxes, local purchases.
2. Cooperate with local press, following policy of giving the whole truth and nothing but the truth.
3. Take part in community celebrations and public exhibits of the products of local industries.
4. Encourage employee participation in civic affairs and official interest in local institutions, hospitals, schools.
5. Discuss company and community affairs with local leaders of thought, such as clergymen, school teachers, bankers and labor leaders.
6. Make plant's appearance an asset to the community by encouraging good housekeeping and attractive surroundings.
7. Arrange for "open house" visits by local people, customer groups and governmental officials.

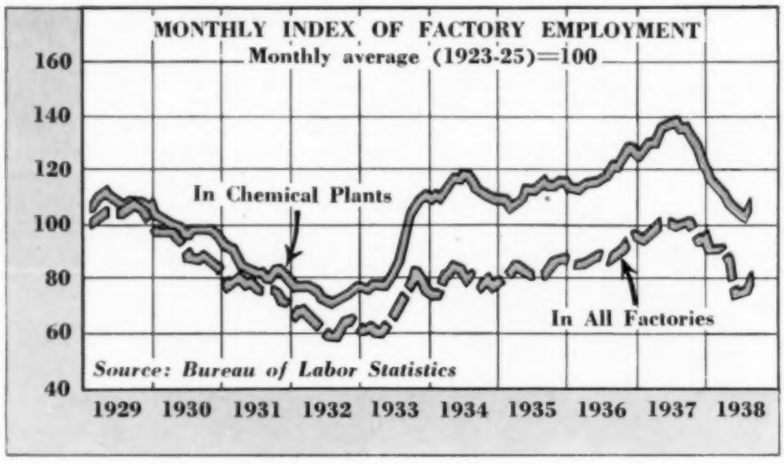
## WITH CUSTOMERS AND GENERAL PUBLIC

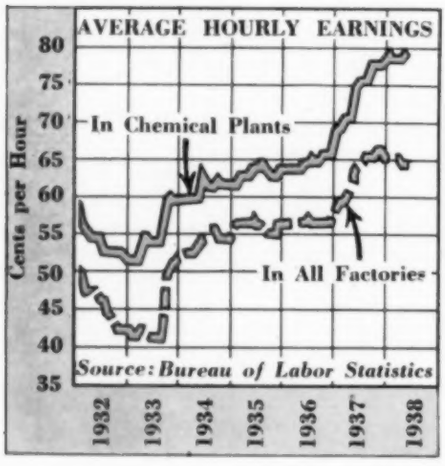
1. Keep customers and public constantly informed about technical developments and accomplishments, price changes, plant expansion and modernization programs.
2. Show how your products raise the general standard of living.
3. Interpret social and economic benefits in terms of human well-being.
4. Through trade and industrial association , local and national, join in programs for education of public and customer groups.
5. Through technical and scientific societies, local and national, qualified employees should publicize interesting facts about new materials and products, improved service, methods of insuring quality.

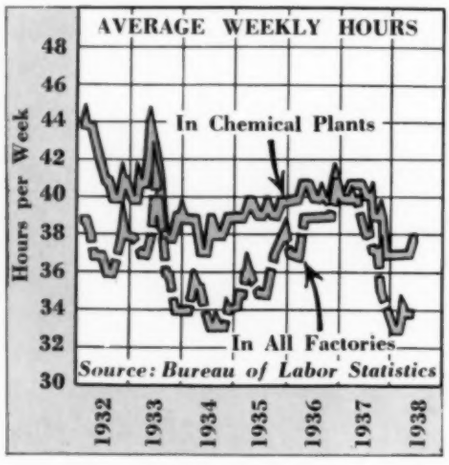
# JOBS

## » MORE JOBS

SINCE 1929 there has been relatively more opportunity for work in chemical plants than in industry as a whole. As new products and materials have been developed, they have provided more and more jobs. These curves for factory employment show how consistently chemical industry has maintained its lead over the "all factories" average.



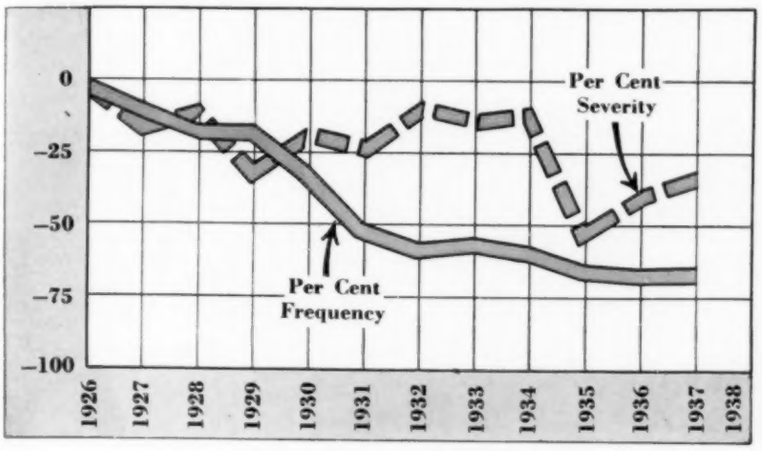




## » BETTER JOBS

WHILE HOURLY EARNINGS in chemical plants have been steadily increasing since 1932, the weekly hours of work have declined from more than 44 to less than 40.

## SHORTER HOURS AND HIGHER WAGES

| Month and Year | Chemicals | | Rayon | | Explosives | | Petroleum Refining | | Pulp and Paper | | All Industries | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average Hours Worked per Week | Average Hourly Earnings (Cents) | Average Hours Worked per Week | Average Hourly Earnings (Cents) | Average Hours Worked per Week | Average Hourly Earnings (Cents) | Average Hours Worked per Week | Average Hourly Earnings (Cents) | Average Hours Worked per Week | Average Hourly Earnings (Cents) | Average Hours Worked per Week | Average Hourly Earnings (Cents) |
| 1932 | 42.4 | 54.5 | 43.5 | 39.8 | 34.3 | 58.6 | 42.2 | 63.2 | .... | .... | .... | .... |
| 1933 | 41.0 | 56.6 | 41.2 | 42.3 | 35.2 | 57.7 | 37.9 | 65.5 | 40.7 | 44.1 | 37.9 | 46.3 |
| 1934 | 38.6 | 61.6 | 37.0 | 50.3 | 34.6 | 62.5 | 34.9 | 75.0 | 36.4 | 51.4 | 34.7 | 54.8 |
| 1935 | 39.7 | 63.6 | 37.9 | 51.4 | 35.9 | 67.6 | 35.0 | 80.1 | 38.9 | 52.9 | 36.7 | 56.7 |
| 1936 | 40.6 | 65.3 | 38.6 | 53.2 | 39.6 | 70.6 | 35.8 | 82.7 | 41.6 | 53.7 | 39.1 | 57.5 |
| **1937** | | | | | | | | | | | | |
| January | 40.2 | 69.7 | 39.0 | 58.1 | 39.7 | 72.2 | 35.5 | 88.2 | 43.3 | 55.9 | 39.6 | 59.6 |
| February | 40.9 | 69.9 | 39.1 | 58.6 | 38.3 | 72.1 | 35.7 | 89.8 | 43.6 | 56.4 | 40.4 | 60.2 |
| March | 40.9 | 71.0 | 39.8 | 58.0 | 49.4 | 75.6 | 36.5 | 88.3 | 43.7 | 56.8 | 41.0 | 61.3 |
| April | 41.1 | 74.9 | 39.8 | 59.8 | 42.3 | 78.5 | 35.6 | 95.1 | 43.4 | 58.4 | 40.4 | 63.8 |
| May | 40.7 | 75.9 | 39.6 | 61.9 | 40.9 | 79.7 | 35.6 | 95.3 | 42.8 | 59.5 | 39.8 | 64.9 |
| June | 40.5 | 76.2 | 39.8 | 62.0 | 39.0 | 79.4 | 36.5 | 95.2 | 42.2 | 61.4 | 39.2 | 65.3 |
| July | 39.9 | 76.3 | 38.6 | 62.7 | 39.0 | 72.9 | 35.5 | 96.6 | 40.3 | 62.2 | 37.9 | 65.7 |
| August | 40.6 | 77.8 | 38.8 | 63.1 | 40.1 | 80.1 | 37.2 | 97.1 | 41.5 | 62.8 | 38.7 | 65.7 |
| September | 38.9 | 78.4 | 38.4 | 64.6 | 38.9 | 79.5 | 35.5 | 97.4 | 39.2 | 63.0 | 37.4 | 65.8 |
| October | 39.6 | 77.9 | 37.4 | 63.8 | 40.5 | 79.5 | 35.9 | 96.9 | 39.5 | 63.1 | 37.6 | 66.6 |
| November | 38.7 | 78.2 | 37.0 | 64.4 | 39.7 | 79.8 | 35.8 | 97.0 | 36.9 | 63.2 | 35.4 | 66.7 |
| December | 37.4 | 78.9 | 35.3 | 65.1 | 37.8 | 78.0 | 36.3 | 97.1 | 35.6 | 63.1 | 34.4 | 66.6 |
| **1938** | | | | | | | | | | | | |
| January | 36.8 | 79.7 | 32.9 | 65.7 | 33.0 | 79.0 | 35.2 | 98.1 | 35.9 | 62.4 | 33.2 | 66.3 |
| February | 37.3 | 79.0 | 32.6 | 65.3 | 37.5 | 80.7 | 36.4 | 97.6 | 37.7 | 62.4 | 34.3 | 65.7 |
| March | 37.0 | 79.0 | 34.3 | 64.7 | 36.2 | 80.5 | 36.2 | 97.0 | 38.2 | 62.2 | 34.5 | 65.5 |
| April | 37.2 | 79.5 | 32.6 | 65.0 | 34.9 | 81.1 | 35.8 | 96.8 | 37.4 | 62.0 | 34.2 | 65.2 |
| May | 37.6 | 78.9 | 34.6 | 64.6 | 34.9 | 81.7 | 37.0 | 97.5 | 37.3 | 62.3 | 34.4 | 65.0 |
| June | 37.7 | 79.3 | 34.6 | 64.8 | 36.4 | 81.5 | 36.3 | 97.8 | 36.7 | 62.5 | 34.4 | 64.8 |




## SAFER JOBS

**Since 1926 chemical plants have reduced the frequency of accidents by 67 per cent and their severity by 32 per cent. The frequency rate for chemical industry is 10.23 disabling injuries per million man-hours of exposure, compared with 13.85 for all industry. The severity rate is 1.29 days lost per thousand man-hours of exposure compared with 1.58.**

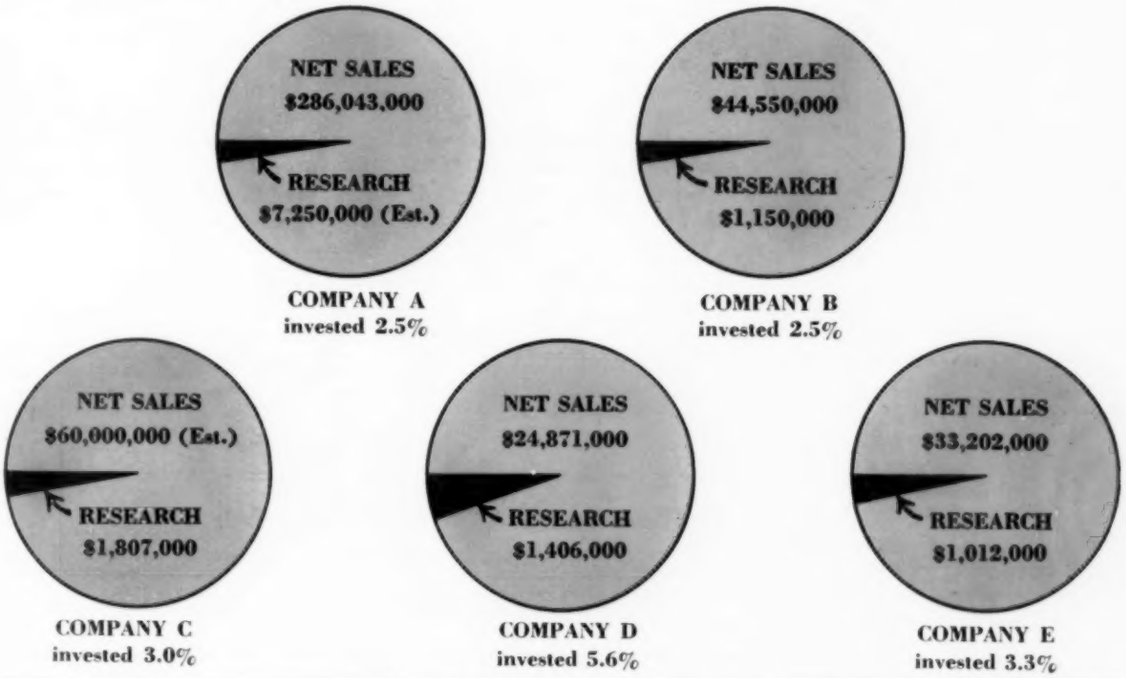
## FUTURE JOBS?

NEW INDUSTRIES, which are constantly being created and developed through advances in science, invention and technology, offer important new opportunities for employment. The National Industrial Conference Board has shown that fifteen major manufacturing industries of today have been developed since 1879, and it has been estimated that these fifteen industries have created, directly and indirectly, 15,000,000 new jobs. On the basis of these figures, at least one out of every four persons gainfully employed today owes his job to one of these industries that had its origin, wholly or in part, in developments resulting from scientific research.

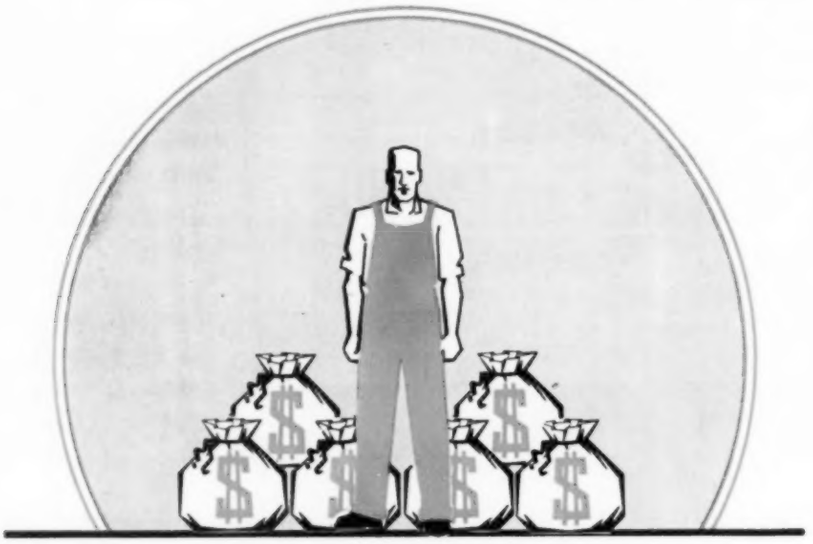
The creation of new chemical industries—and therefore of new opportunities for employment—is a continuing process. Today many chemical companies report that fully half of their profits have come from the manufacture and sale of new and improved products which are the results of research of the past eight or ten years. Since 1928 one century-old company has developed twelve new groups of products that now give employment to 18,000 workers in plants that represent an investment of $174,000,000.

Research is, therefore, our most promising sources for future jobs—as well as profits. From the laboratories come the new products, new uses and the new and improved processes that make better goods available at constantly lower prices.

Twenty million dollars is a conservative estimate of the amount of money spent last year by chemical manufacturers in research to provide future jobs. Process industries added many millions more to this total. Out of each $100 of sales of organic chemicals last year, $4.30 went for research. The charts below show typical sales percentages for five important chemical companies.



# MONEY



## BEHIND EVERY JOB IN AMERICAN CHEMICAL INDUSTRY IS INVESTED

# $11,250

## This Means That

THERE IS AN IMPORTANT RELATIONSHIP between employment and the large amount of money that must necessarily be invested in the chemical process industries. For every job in a chemical plant, someone must have put up an average of $11,250 for each wage earner. Employment can be increased only as earnings are plowed back into the business or as other people's money is invested in plants and equipment. There is no other way in which industry can increase its payroll, at the same time continue the efficiency of its service to customers and to the public.

Last year a study was made of more than a hundred chemical companies employing approximately 112,000 people—of which 81,131 were factory wage earners and 30,770 were salaried employees. These plants reported that as of December 31, 1936, they had a total investment of $912,704,988 which included capital assets (the value of land, buildings, equipment and other property used in the business, less depreciation) of $584,540,265 and working capital (total cash, including current funds temporarily invested, receivables, inventories and prepayment, less current bills) of $328,164,723. This meant that for all factory wage earners, the investment in capital assets averaged $7,205 and the requirements for working capital were $4,045.

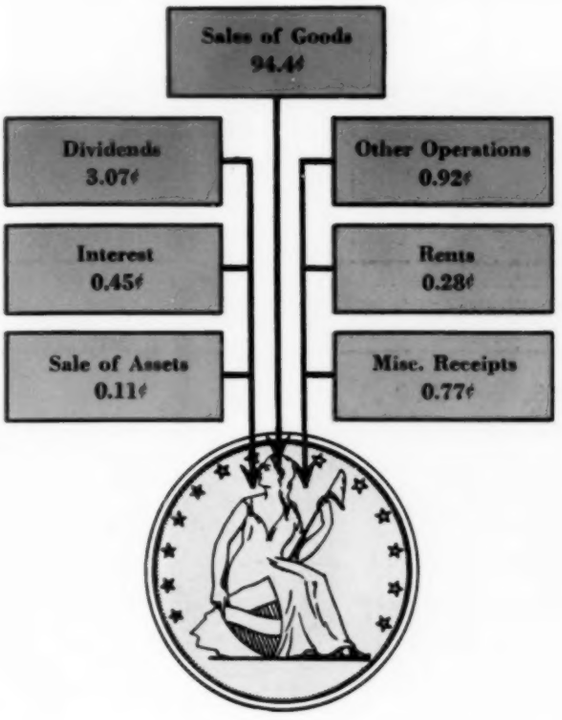
One important company reported in 1937 that its investment per employee was divided as follows: Machinery and equipment, $4,619.76; Buildings for laboratories, plants and offices, $1,454.31; Inventories of finished goods and raw materials, $1,438.34; Reserves and working capital, $1,344.71; due from customers, $547.75; lands and mines, $407.97; miscellaneous, insurance deposits and other investments, $198.91—making a total of $10,011.75.

As his return on this investment, the average employee receives in excess of $1,200. The stockholder who had invested $10,000 in this company last year received a return of $366 in dividends, but he had also provided a job for at least one new factory worker in chemical industry and that is the only way that jobs are made. Capital and labor have a common interest in the continued success of American chemical industry.

**Investment[1] and Average Investment per Employee of 107 Companies Reporting 111,901 Employees[2]**

| Investment | Amount | | Average per Employee | |
|---|---|---|---|---|
| | Actual | Percent of Total | All Employees | All Factory Wage Earners |
| Capital Assets | $584,540,265 | 64.0 | $5,224 | $7,205 |
| Working Capital | 328,164,723 | 36.0 | 2,932 | 4,045 |
| Total | $912,704,988 | 100.0 | $8,156 | $11,250 |

[1] As of December 31, 1936, or close of completed fiscal year nearest that date.
[2] Includes 81,131 factory wage earners and 30,770 salaried employees whether occupied in factories or offices.




## WHERE THE CHEMICAL DOLLAR COMES FROM

**Sources of Income for Chemical Process Industries**
(In Thousands of Dollars)

| | Chemical and Allied Products | Pulp and Paper | Rubber Goods | Leather Goods |
|---|---|---|---|---|
| Gross Sales | 6,284,780 | 1,280,148 | 712,051 | 1,018,483 |
| Receipts from Other Operations | 61,083 | 4,594 | 6,018 | 3,445 |
| Interest | 38,334 | 12,730 | 5,028 | 2,662 |
| Rents | 18,784 | 4,221 | 9,241 | 1,167 |
| Net Capital Gains | 7,560 | 1,139 | 1,803 | 400 |
| Dividends | 195,625 | 4,961 | 18,576 | 1,050 |
| Other Receipts | 51,126 | 8,784 | 4,233 | 6,677 |
| Total Incomes | 6,657,292 | 1,316,576 | 756,950 | 1,033,885 |

*Source: Tax returns to U. S. Treasury Department*

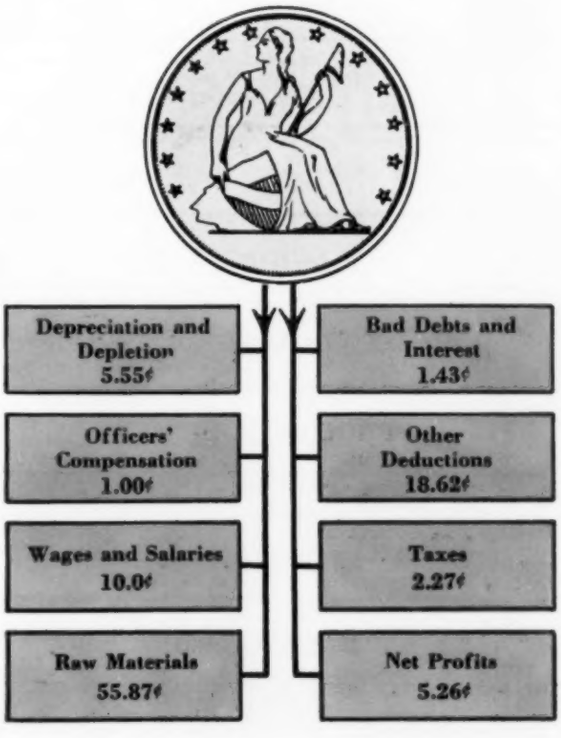


## AND WHERE IT GOES

**Percentage Distribution of Income Paid Out by Chemical & Petroleum Refining Industries as Compared with Totals for All Industries**
(In Per Cent of Total)

| | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 |
|---|---|---|---|---|---|---|
| Salaries | 18.8 | 17.8 | 18.7 | 20.3 | 18.8 | 17.2 |
| Wages | 40.1 | 34.9 | 34.8 | 37.8 | 39.2 | 40.8 |
| Dividends | 37.1 | 42.7 | 40.0 | 33.8 | 34.9 | 36.2 |
| Interest | 2.4 | 2.9 | 4.6 | 5.6 | 4.8 | 3.6 |
| *All Industry* | | | | | | |
| Salaries | 22.1 | 24.6 | 26.5 | 28.5 | 25.7 | 22.8 |
| Wages | 59.9 | 54.9 | 53.6 | 53.5 | 57.6 | 61.1 |
| Dividends | 14.3 | 16.4 | 15.3 | 13.1 | 11.9 | 12.0 |
| Interest | 1.2 | 1.6 | 1.8 | 2.2 | 2.1 | 1.6 |

*Source: United States Department of Commerce*



## CHEMICAL PROCESS INDUSTRIES BUY

| | WORTH | FROM |
|---|---|---|
| **RAW MATERIALS** | | |
| MINERALS | $3,000,000,000 | Mines |
| AGRICULTURAL PRODUCTS | $850,000,000 | Farms |
| FOREST PRODUCTS | $300,000,000 | Forests |
| **TRANSPORTATION** | | |
| RAIL | $800,000,000 | Railroads |
| HIGHWAY | $140,000,000 | Truckers |
| WATERWAYS | $60,000,000 | Barge and Ship Lines |
| **FUEL AND POWER** | | |
| COAL | $562,000,000 | Mines |
| GAS | $105,000,000 | Gas Works |
| OIL | $115,000,000 | Petroleum Companies |
| ELECTRICITY | $118,000,000 | Public Utilities |
| CONTAINERS | $500,000,000 | Manufacturers |
| PROCESS EQUIPMENT | $250,000,000 | Equipment Makers |
| **NEW BUILDINGS** | | |
| FACTORIES | $150,000,000 | Builders |
| WAREHOUSES | $50,000,000 | Builders |
| TOTAL | $7,000,000,000 | |

# SELL

| TO | WORTH | |
|---|---|---|
| Industries | $1,090,000,000 | CHEMICALS |
| Industries, Homes | $585,000,000 | COKE AND GAS |
| Hospitals, Homes | $417,000,000 | DRUGS, MEDICINES AND COSMETICS |
| Industries, Homes | $340,000,000 | DYEING AND FINISHING TEXTILES |
| Miners, Builders | $47,000,000 | EXPLOSIVES |
| Farmers | $140,000,000 | FERTILIZERS |
| Industries, Builders, Homes | $463,000,000 | GLASS AND CERAMICS |
| Industries, Families | $308,000,000 | LEATHER, TANNED |
| Industries, Builders | $144,000,000 | LIME AND CEMENT |
| Industries, Homes | $375,000,000 | OILS AND FATS |
| Industries, Builders, Homes | $417,000,000 | PAINTS, PIGMENTS AND VARNISH |
| Publishers, Converters | $879,000,000 | PAPER AND PULP |
| Industries, Homes | $1,839,000,000 | PETROLEUM PRODUCTS |
| Textile Mills | $185,000,000 | RAYON |
| Industries, Homes | $678,000,000 | RUBBER GOODS |
| Homes, Industries, Laundries | $282,000,000 | SOAP |
| Food Plants, Homes | $499,000,000 | SUGAR |
| Industries, Homes | $1,312,000,000 | OTHER PRODUCTS |
| | $10,000,000,000 | TOTAL |

# SERVICES

## To the Community

**1.** BECAUSE CHEMICAL PROCESS INDUSTRIES provide regular and profitable employment for many citizens, the plant community is materially benefited. Business is better for its mercantile establishments. From the weekly pay-envelopes comes the money for food and clothing, for furniture, for the automobile and its gasoline, the washing machine, the radio, and for the doctor and the dentist. Chemical communities grow and prosper as their industries grow and prosper.

**2.** LOCAL TAXES PAID by chemical process industries have contributed important community developments in many localities. Better schools and hospitals, parks and playgrounds, recreation centers and golf courses, all come, directly or indirectly, from levies on factory buildings and payrolls.

**3.** CHEMICAL MANUFACTURING calls for a high type of personnel in the plants, laboratories and offices. Salaried employees in chemical industries represent 28.2 per cent of the total number of employees as compared with only 12.7 per cent for all manufacturing industries. An unusually large proportion of these are college-trained professional men who contribute greatly to the social and cultural life of any community.

**4.** COMPANY OFFICIALS participate actively in many community affairs. They hold offices or membership in local service clubs and chambers of commerce. They serve on committees for community chests, hold drives for hospitals and charitable institutions, and youth organizations such as the Boy and Girl Scouts, and the Y. M. and Y. W. C. A.'s. Good citizenship is a requisite for advancement in most chemical companies.

**5.** BY CONSTANT ATTENTION to safety and health in its plant operations, chemical manufacturing has made much greater progress than industry as a whole. As a result, chemical communities are generally healthy places in which to live and rear a family. And since chemical industry itself is a growing enterprise, there is always increasing opportunity for personal progress and development.

# To the Nation at Large

1. BY MAKING AVAILABLE new materials at lower prices, chemical industries have helped to raise American standards of living. The automobile is essentially a product of chemical and metallurgical research. Radios are built of plastics and of once-rare metals and chemical elements. Rayon, cellophane, sun-fast dyes, safety glass and movie films are synthetic materials that add to the comfort and conveniences of living. In fact, chemical industry has done more than any other to turn luxuries into the common things used by everybody.

2. BECAUSE CHEMICAL INDUSTRY has constantly improved the quality of its products, it has not only saved the public tremendous amounts of money, but it has protected it against fraud and adulteration. The 15,000,000 American families who drive Fords, Plymouths and Chevrolets, are saved $517,000,000 each year merely as a result of improvements made in the manufacture of automobile tires during the past twelve years. Multiply that saving by the number of other common things that have been improved through chemical research!

3. CHEMICAL INDUSTRY HAS FREED this nation from dependence upon foreign monopolies for many essential medicines such as iodine, camphor, salvarsan and aspirin. Nitrates from the air and potash from New Mexican mines and California brines make it unnecessary for us to pay tribute to foreign powers for these vital plant foods. Strategic raw materials such as rubber, can be replaced, in case of emergency, by synthetic materials that have already been developed in chemical research laboratories.

4. CHEMICAL INDUSTRY HAS MINISTERED to the public health through improved sanitation, as in the purification of public water supplies. In twenty-five years chlorination of water has reduced the typhoid-fever death rate from 22.5 to 1.3 deaths per 100,000 population.

5. BECAUSE OF THE CLOSE INTER-RELATION, resourcefulness and inherent flexibility of chemical industry, many peace-time plants could quickly be converted to the manufacture of explosives, poison gases and chemical munitions that would provide us with the basis for national defense in case of war. Chemical preparedness is a practical and realistic approach to peace.

# FACTS

## About Industry

**1.** IN LITTLE MORE than 100 years, while population has increased 13½ times and the number of men on the farms has increased 5½ times, jobs in industry have increased 48 times. America has become an industrial nation. More of us make our living that way than in any other. So industry is "our" best business.

**2.** SINCE 1879 with better factories and more machines, while factory jobs have increased 3¼ times, factory wages have grown nearly 11 times. While industry has given us automobiles, radios, rayon, cellophane, and plastics, more of us have had better incomes.

**3.** IN THIS SAME PERIOD, 16 new industries alone have created more than a million new jobs directly and maybe 15,000,000 indirectly. These include many chemical and electrical products, automobiles, cash registers, aircraft and motion pictures.

**4.** IN THE PRESENT CENTURY, national wealth per person has risen from $1,450 in 1900 to $2,100 in 1934 (latest figures available). National income per person has increased from $209 in 1899 to $391 in 1934 ($539 in 1937, $664 in 1929).

**5.** AND WHILE THIS WAS HAPPENING, for over 100 years, wages have gone up more rapidly than prices, so that employees' incomes purchase more. In other words, the income rose faster than the cost of living.

**6.** ALL THIS HAS CREATED the American standard of living, raised it to a plane of security, opportunity and enjoyment, surpassing in advantages every other nation on this earth.

**7.** IN THOSE "BIG YEARS" 1923-1929, the manufacturing industries actually paid out five times as much in wages and salaries as in dividends, twenty times more than they returned as surpluses.

**8.** PROFITS OVER A TEN-YEAR PERIOD like 1923-1933, with its good years and bad, average 4.2 cents on the sales dollar or 4.3 cents for each invested dollar. In good years, three out of five plants made a profit; in bad years only one out of four.

**9.** EXECUTIVE SALARIES, in a reasonably good year like 1935, were only 3 per cent of payrolls, only 0.6 of 1 per cent of sales. Had they been divided equally among factory employees, each would have received but 79 cents more a week.

**10.** DURING THE PERIOD 1923-1934, factories paid out for federal, state and local taxes from 1.7 cents to 2.6 cents of each sales dollar. Taxes for industry as a whole were as high as 12.9 cents per payroll dollar and 71 cents per dividend dollar. In some chemical industries they exceeded 50 per cent of the average annual wage and several times the dividends.

★ **Can you put these facts to work in company conferences with employees, in public addresses, radio talks, or newspaper articles? If more information or further details are desired, address Public Relations Editor, *Chem. & Met.*, 330 West 42nd St., New York.**

# Electrochemists Convene

***New developments in the electrodeposition and use of silver and its alloys, use of plastics in the industry, and recent investigations in corrosion were among the topics discussed.***

EDITORIAL STAFF

THE 74TH MEETING of the Electrochemical Society was held in Rochester, N. Y., October 12–15. Members and guests were given an opportunity to visit the Eastman Kodak Co., the Taylor Instrument Co., Bausch & Lomb and other organizations. The technical sessions featured the metallurgy and use of silver, plastics in the electrochemical industry, corrosion of metals and alloys and electrodeposition.

The symposium on silver was held under the chairmanship of Lawrence Addicks. The electrodeposition of silver from solutions of silver nitrate in the presence of addition agent was discussed by Robert Taft, professor of chemistry, University of Kansas, and Lee H. Horsley, research chemist, Dow Chemical Co., Midland, Mich. A preliminary study of the brighteners in silver-plating solutions was reported upon by B. Egeberg and N. E. Promisel of the International Silver Co., Meriden, Conn.

Silver plating from acid complex iodide baths was the subject of a paper by D. K. Alpern, assistant professor, Brooklyn College of the City of New York, Brooklyn, N. Y., and S. Toporek, a student at the same institution. Prof. Colin G. Fink, head of electro-chemistry, Columbia University, New York City, and V. S. de Marchi, American Silver Producers' Research Fellow, research assistant, Columbia University, reported that corrosion studies of iron-silver alloys showed that small amounts of silver, up to about 1 per cent, improved the resistance of iron to the corrosive action of 10 per cent hydrochloric acid and 30 per cent acetic acid, iron containing small percentages of silver behaves similarly to iron containing small percentages of copper. The preparation of silver membranes was discussed by Harold J. Read, and Martin Kilpatrick, duPont Fellow in Chemistry and associate professor of chemistry, respectively, University of Pennsylvania, Philadelphia, Pa.

Corrosion of silver anodes in potassium silver cyanide plating solution was discussed by A. E. Thurber, technical supervisor, Daniel Gray, and R. H. Sholtz, research engineers, Oneida, Ltd., Laboratories, Oneida, N. Y. The electrodeposition of silver alloys from aqueous solutions was the subject of a talk by A. D. Johnson and F. C. Mathers. The appearance of thick silver plate on steel was discussed by Mathers and L. I. Gilbertson. The final paper in the silver group was on the cold welding of silver by Allison Butts and G. R. Van Duzee.

With the growing importance of plastics, the Society found it advisable to devote an entire session to plastics in the electrochemical industry. S. O. Morgan of the Bell Telephone Laboratories, New York City, was in charge of the meeting. The methacrylic ester resins were discussed by H. R. Dittmar, D. E. Strain and R. Grice Kennelly, E. I. duPont de Nemours & Co., Wilmington, Del. The properties of these resins render them suitable for general industrial uses as coating materials and as thermoplastic adhesives applicable in the form of lacquers, solvent-free hot melts or emulsions. Dielectric tests on films of shellac varnish were discussed by Erik Ackerlind, electrical engineer, Brooklyn, N. Y., and Ernst Weber, research professor, Polytechnic Institute, Brooklyn, N. Y. The polymerization of acetylene gas has been accomplished by low velocity electrons (40–90 e.v.). The results were discussed by George Glockler, and F. W. Martin, Department of Chemistry, University of Minesota, Minneapolis, Minn. The material had a yellow color and behaved like cuprene. The characteristics and practical applications of some of the vinyl resins were described by S. D. Douglas, research and development department, Carbide and Carbon Chemicals Corporation, South Charleston, W. Va. V. E. Meharg of the Bakelite Corp., Bloomfield, N. J., discussed thermosetting resins and stated that the physical and chemical properties can be varied within certain limits by modification of the resins or their heat-hardening treatment. Dimensional stability and moisture resistance are valuable properties displayed by these resins.

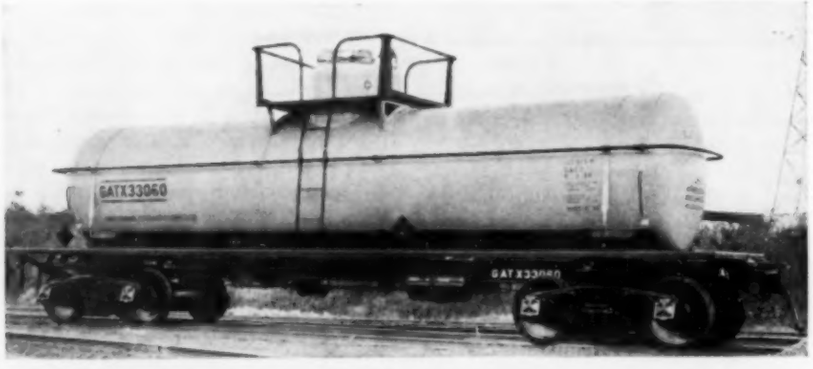
The dielectric constant and loss of plastics as related to their composition was the subject of a paper by W. A. Yager, Bell Telephone Laboratories, Summit, N. J. The preparation of polyvinyl chloride plastics for electrical measurement was discussed by Raymond M. Fuoss. The study of the viscosity and dielectric dispersion of methacrylate resins in benzene solutions was discussed by G. W. Gross, H. C. Ott and O. M. Arnold. Ethyl cellulose films and plastics were discussed by S. L. Bass and W. C. Groggin. The classification and chemical genetics of organic plastics was another paper on the program. It was presented by Gordon M. Kline of the National Bureau of Standards, Washington, D. C.

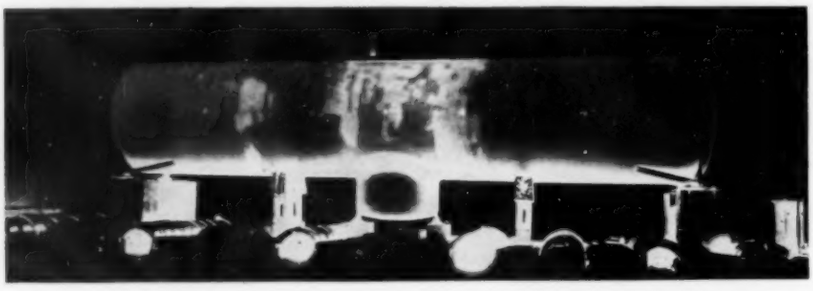
Several papers were presented that dealt with the subject of corrosion. The elctrochemistry of corrosion was covered by R. H. Brown and R. B. Mears, Aluminum Research Laboratories, New Kensington, Pa. The anodic and ordinary corrosion of ferrous metals in various acids was reported on by Raymond R. Rogers, instructor in chemical engineering and Edgar Bloom, Jr., graduate in chemical engineering, Columbia University, New York City. Hydrochloric, sulphuric, nitric and phosphoric acids of various concentrations were used. A theory of cathodic protection was the subject of a second paper by Mears and Brown of the Aluminum company. The effect of pressure on the passivity of various metals was discussed by Clarence A. Littler, graduate student, with H. V. Tartar, professor of chemistry, University of Washington, Seattle, Wash. The object of the work was the determination of the effect of reduced pressure on the periodic passivity of certain metallic anodes. The authors found that reduced pressure maintained the activity of iron completely immersed in nitric acid but does not produce activity in iron already passive.

Papers were also presented on electrodeposition and other topics.

# Tank Cars for Pure Chemicals

***Stainless steel "stabilized" with columbium provides long life containers for handling and transporting chemicals of extremely high purity as shown by new tank car construction.***



**A stainless steel ("stabilized" with columbium) tank car built for the transportation of chemicals such as butyraldehyde which must remain iron-free is shown here in two views—top, as a finished product; and bottom, just as it came from a gigantic stress-relieving furnace**

DELIVERY OF CHEMICALS of high purity is often impossible with ordinary transportation equipment—especially when a commodity must be maintained iron-free to the extent of one part or less per million. Since chemicals with that purity specification are now in commercial demand in tank car quantities, a car made of a new type of stainless steel was required, and is now available.

The few welded straight-chromium stainless steel tank cars heretofore available were unsuitable for these severe requirements. The evidence available regarding the columbium stabilized 18-8 chrome-nickel steel indicated that this material would be satisfactory in all respects.

It required special action of the Tank Car Committee of the Association of American Railroads and of the service division of the Interstate Commerce Commission to authorize the building of such a tank car. Hence official approval was secured by General American Transportation Corp. to build five units. The tank for the first of these cars was constructed in the shops of Hedges-Walsh-Weidner Division of Combustion Engineering Corp., Inc., and is being used by Carbide and Carbon Chemicals Corp. in the regular transport of chemicals of high purity.

There was a question as to whether a clad metal tank or one of solid alloy would be better, but, although somewhat more expensive, the solid stainless steel was chosen. Therefore, the tank was constructed of three shell plates, each weighing approximately 5,000 lb., with deep dished single-piece heads of the same metal for closure. The tank itself is 6 ft. 6 in. in diameter by approximately 33 ft. long and will carry, fully loaded, 8,000 gal.

The main body of the tank was assembled by one set of staggered longitudinal seams in the three shell plates, and four circumferential welded seams. Welding of the assembly has two advantages: (1) it prevents leakage through riveted joints, and (2) contamination of the chemical from dirt or residual matter which might accumulate in the crevices along a line of rivets is avoided.

Following assembly of the tank the whole shell was stress-relieved in a furnace. Low carbon steel containing ten times as much columbium as carbon was used since columbium is said to prevent susceptibility to intergranular decay after exposing the tank to the stress relieving temperature so that a tank of this material is in every sense as good as one made of a fully heat treated 18-8 chrome-nickel steel.

## Iron-Silver Alloys

CONTRARY TO POPULAR BELIEF, silver does alloy with iron, according to Fink and de Marchi of Columbia University. A number of experiments with the new alloys were described in a paper presented before The Electrochemical Society meeting at Rochester, October 12-15.

Outstanding characteristics of the alloys are: (1) Maximum amount of silver dissolved in the ferrite grains is between 0.5 and 1.0 per cent; (2) behavior of the alloys is very similar to that of iron-copper alloys; (3) small amounts of silver definitely improve the resistance of the iron to the corrosive action of 10 per cent hydrochloric acid and 30 per cent acetic acid. In addition, ohmic resistance measurements prove beyond doubt that a true alloy bond does exist.

The proof of a positive alloy bond between iron and silver explains the good adhesion of electrodepositions, shows that a copper undercoating is unnecessary, and opens up the possibility of iron-to-silver welding.

To prepare the alloys it was necessary to mix thoroughly exact quantities of iron powder and silver crystals, submit them to 41 tons pressure and sinter for 4 hours at 950 deg. C. in an atmosphere of hydrogen. The resulting bars were then cold-rolled and heat-treated before experimentation.

# Petroleum Exposition

THE SCIENCE OF PETROLEUM. A Comprehensive Treatise of the Principles and Practice of the Production, Refining, Transportation and Distribution of Mineral Oil. 4 Vols. Edited by *A. E. Dunstan, A. W. Nash, B. T. Brooks and Sir Henry Tizard.* Published by Oxford University Press, New York, N. Y., 1938. 3,192 pages. Price complete, $85.

Reviewed by *R. H. Price*

THE PETROLEUM INDUSTRY has long felt the need of a comprehensive treatise such as this. In an age of specialization few men have time to become thoroughly familiar with the technical advances and current practices in fields other than their own through wide reading of technical literature. Even within a single large industry there is too great a tendency, through lack of time, to specialize within a narrow field. "The Science of Petroleum" should aid greatly the many men who desire to broaden their knowledge of the petroleum industry.

The sub-title of this treatise reveals its broad scope. Authoritative sources of material have been used. The 316 contributors not only relied upon available technical literature for their material but to some extent made use of records and information from the archives of industrial companies. The numerous references given constitute a valuable bibliography.

Volume I is quite properly devoted primarily to the origin and production of petroleum. Section 1 of this volume gives a valuable treatment of the nomenclature of crude oil, petroleum products and bitumens. An interesting section presents the evidence in support of the various theories of the origin of petroleum. Particularly valuable is the section on the stratigraphical and geographical distribution of petroleum throughout the world. Sections presenting geological and geophysical methods of exploration are logically followed by discussions of drilling, sampling, coring, and bore-hole surveying. Among the numerous phases of production which are discussed rather completely are: drainage of petroleum from its reservoir rocks, potential oil yields, control of water in oil reservoirs, oil field repressuring and oil-well pumping.

Chemical demulsification and electrical dehydration of crude petroleum receive fairly adequate treatment, although practically no reference is made to the closely related and increasingly important problem of desalting crude. The concluding sections are devoted primarily to the subjects of transportation and storage of oil and gas and includes, among others, well-prepared treatments of the law of fluid flow in pipelines, corrosion and protection of pipelines, modern pipeline practice, the modern tanker, pressure storage, floating roof tanks, and evaporation losses.

Volumes II and III deal with the chemical and physical principles of refining. Volume II opens with a section on the physical characteristics of representative oils and their fractions from commercially important producing areas throughout the world. A valuable section is the one on the chemistry of petroleum. Some subdivisions of this section, as for example that devoted to the chemistry of hydrocarbons, are covered more adequately than is required perhaps in a treatise of this sort. The content and importance of Section 20 is indicated by its title—Physical and Chemical Properties of Petroleum and its Products: Determination, Correlation and Collected Data. A large group of contributors has succeeded in filling this section full of valuable basic data.

No treatise of this sort would be complete without some presentation of methods of testing petroleum products. In one of the sections in Volume II the various tests are presented with adequate explanations of their significance.

After briefly taking up casinghead gasoline extraction and natural and refinery gases, a final section is devoted solely to distillation. This latter subject, of such basic importance in petroleum refining, includes discussions of the application and use of equilibrium constants, the theory and application of absorption and stripping factors and a comparative analysis of methods of design of gas absorbers, strippers and fractionating equipment.

Volume III is largely devoted to consideration of refinery practice and to general problems encountered in the refining field. A section on physical refining processes includes a general discussion of adsorption and interesting papers covering percolation, contact filtration, the use of acid-treated clays in the industry and the treatment of cracked gasoline with fuller's earth. Under the section on chemical refining processes the authors have properly devoted considerable space to the chemistry of refining light distillates and lube oils and, in view of its importance, the use of sulphuric acid in oil treating. Among the sweetening methods the hypochlorite and plumbite methods naturally are particularly stressed, but little or no mention is made of some others which have been assuming commercial importance. The treatment of the subject of sulphur removal from gases is well handled. A valuable discussion of the theory of solvent extraction and numerous laboratory and plant data from tests of the more important solvent-extraction processes are included in Section 28. Other sections of major importance to be found in this volume deal with dewaxing, gas pyrolysis and polymerization, cracking, hydrogenation and corrosion.

Another section is devoted to engineering and chemical engineering as applied to refining and is well-presented in condensed and yet thorough fashion. The subject of cracking is ably presented in condensed (perhaps too condensed) form. The section dealing with corrosion seems inadequate (14 pages) considering the importance of this subject. The sections dealing with gas pyrolysis, polymerization and hydrogenation are comprehensive and well-presented.

Volume IV is divided into three main parts, one dealing with utilization of mineral oils and their derivatives, another with detonation and combustion, and finally one on bituminous materials and their products. The portion on utilization covers a large number of products, as would be expected, ranging in character from natural gasoline to asphalt. Considerable space is properly devoted to discussion of synthetic products derived from petroleum.

A helpful discussion of hydrocarbon combustion phenomena, both at atmospheric and high pressures, precedes a logical development of the interesting subject, detonation, which includes not only a theoretical treatment of ignition and flame propagation, but also a rather com-

plete presentation of the specific behavior of fuels aud addition agents and discussion of methods of knock testing.

Considerable repetition is noted throughout these volumes. This at first appeared to the reviewer to indicate insufficient editing. However, upon second thought it seems probable that the editors considered that the volumes would be used primarily for reference purposes instead of as a coherent story of petroleum for evening reading. If such was their thought then each subject should be presented in a reasonably complete form without regard to occasional overlapping in fundamental explanatory material.

The volumes are well-indexed both as to names and subject matter. The quality of paper and printing is good. The editors and all who contributed in this splendid undertaking should be commended for a task well done.

## THE CHEMISTRY OF INDUSTRY

INDUSTRIAL CHEMISTRY. Second Edition. By *William Thornton Read.* Published by John Wiley & Sons, Inc., New York, N. Y., 1938. 605 pages. Price, $5.

Reviewed by *Joseph H. Koffolt*

THE GENERAL PLAN, organization, logic, objectives, and subject matter of this book follow closely those of the first edition. Although the number of chapters and their headings remain practically unchanged, much of the material has been rewritten and brought up to date with the cooperation of over a hundred men in industry, each a specialist in his particular field.

The first section gives a general background of the chemical industries—their historical development, their technical organiaztions, their literature sources, the importance of technical and economic control in their operation, and the qualifications required of men employed in them.

The chapter on "unit operations" and equipment is presented on a purely descriptive basis. However, reference is made to the various sources where complete discussion of calculations can be found. Of special note are the clear-cut and informative illustrations of equipment.

The classification of industries is again in most cases based upon chemical similarity rather than on processes or products. This is really not objectionable as the subject matter is well indexed and the arrangement tends for easy and pleasant reading, especially if the book is to be used for collateral references, as a digest of modern chemical industry, or as an introduction to the more comprehensive treatises and monographs of specialized industry. Emphasis is placed on the application of chemistry rather than on the integration and coordination of the factors which eventually must be studied in the detailed analysis of any industry, namely, the problems of the market, the chemistry, and the engineering. However, such an arrangement would make the book voluminous and destroy the perspective which enables it to fill the needs of a diversified class of readers. It was for the latter reason that problems were omitted, the author believing that they are best prepared by individual instructors to meet their own particular needs.

The book is highly recommended by the reviewer as a clear, substantial, informative, and cultural survey of chemical industry. It is well written, and it is anticipated that it will meet with the same enthusiastic reception as the first edition.

## NEW TEXTBOOKS

GENERAL CHEMISTRY. By *Eugene P. Schoch* and *William A. Felsing.* Published by McGraw-Hill Book Co., New York City. 524 pp. Price, $3.25.

Reviewed by *R. L. Taylor*

BASED ON a special text used at the University of Texas for nearly 30 years, this book is perhaps a more rigidly fundamental presentation of general chemistry than any other of the first year college textbooks on the subject. The inorganic material, for example, is presented in two distinct divisions based upon the general types of chemical reactions, i.e., (1) simple reactions in which there is no change of valence and (2) oxidation-reduction reactions. Fundamental principles of each type are stressed "with just enough descriptive material to furnish a basis for generalizations." It is intended that the interest of the student will be maintained by frequent remarks and illustrations relative to industrial applications.

Of the total pages in the book 16 per cent are devoted to elementary organic chemistry, a larger proportion than was found by Prof. Ralph Dunbar in any of the twelve representative college general chemistry textbooks included in his 1937 survey. This seems to be justified, however, in the authors' stated attempt to present a "fairly complete picture of the province of chemistry." The organic section is of a more descriptive nature than the rest of the book.

Laboratory directions are interspersed throughout the text, and fundamental definitions, laws, and principles are emphasized by the use of heavy type. This book is a departure from the usual general chemistry text and should prove a very effective teacher.

INTRODUCTORY QUALITATIVE ANALYSIS. By *Warren C. Vosburgh.* Published by Macmillan Co., New York City. 222 pp. Price $2.25

AS IN the first book written by the author and Dr. Jacob Cornog, emphasis in this new enlarged edition is placed on chemical principles and the scientific method rather than on complete coverage of analytical tests. This treatment seems to be justified in view of the fact that the text is especially designed for the beginning student.

The book is divided about evenly into two separate sections on laboratory work and theory. An unusual feature is that laboratory directions are adaptable to either ordinary or semi-micro work, milliliters simply being read as "drops" in the latter case except where special directions are inserted in italics.

QUALITATIVE CHEMICAL ANALYSIS. Second edition. By *Louis J. Curtman.* Published by Macmillan Co., New York City. 514 pp. Price, $3.75.

THE ORIGINAL PLAN of including the essential material for a one semester course in the first four parts of the book and advanced material in the last section has been retained in this edition.

In the section on theory, the discussion of atomic and molecular structures has been expanded and important new additions made in introducing the Brönsted theory of conjugate acids and bases. The oxonium (or hydronium) ion concept, as suggested by this theory, is used in place of hydrogen ion throughout the book. The advanced section, which is essentially on acid analysis, includes much recent work conducted in the author's laboratory at the College of the City of New York and should appeal to the industrial analyst working on complex mixtures containing many anions. Also in this section is a brief discussion of microanalysis.

PROBLEMS IN ORGANIC CHEMISTRY. By *Ernest Hamlin Huntress.* Published by McGraw-Hill Book Co., New York City. 270 pp. Price, $2.25.

A GOOD stiff drill covering all the essential principles of organic chemistry is contained in this little book which lists 835 problems and questions (without answers) ranging all the way from writing the structural formula for tetramethylmethane to synthesizing caffeine from the elements and recommending a contemporary organic chemist for the Nobel prize.

The book is the work of an M.I.T. professor who felt the need of something to give his students additional practice in the actual use of principles taught in lectures and the regular organic textbooks. It is divided into four sections as follows: (1) monofunctional compounds of the alipathic series; (2) corresponding compounds of the aromatic series; (3) polyfunctional compounds drawn from both series; and (4) miscellaneous review and advance problems. The first three sections are designed for students taking the usual one year course, the last section for advanced students. We might also add that practicing industrial "organickers" desiring a little extracurricular exercise couldn't find it in a more concentrated form.

NUMERICAL PROBLEMS IN ADVANCED PHYSICAL CHEMISTRY. By *J. H. Wolfenden.* Published by Oxford University Press, London and New York. 247 pp. Price, $2.75.

WOLFENDEN states in his preface that the purpose of his problem book is an attempt to bridge the widening gap between theory and experimentation in the teaching of physical chemistry. The book is a collection of 133 problems having to do with stoichiometry, equilibria, thermodynamics, electrochemistry, radioactivity and other physico-chemical phenomena.

The problems are based, with a few exceptions, on authentic data taken from various papers published within the past 15 years. They are independent and classified both as to content and difficulty to allow an easy selection. Most of the problems follow the general form: reference to the original paper, a brief explanation of the problem, various textbook references, and hints as to the methods of solution. Answers to the problems are provided in the back of the book in a complete, explanatory fashion. The book has been designed in such a way that it can be used with any one of 13 standard textbooks on physical chemistry.

## GOVERNMENT PUBLICATIONS

*Documents are available at prices indicated from superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.*

**Notes on the Sampling and Analysis of Coal,** by A. C. Fieldner and W. A. Selvig. Bureau of Mines, Technical Paper 586; 10 cents.

**Methods for the Detection and Determination of Carbon Monoxide,** by L. B. Berger and H. H. Schrenk. Bureau of Mines, Technical Paper 582; 10 cents.

**Flotation for Recovery of Scheelite from Slimed Materials,** by E. S. Leaver and M. B. Royer. Bureau of Mines, Technical Paper 585; 10 cents.

**A Technique for Use of the Impinger Method (Dust Counting),** by Carlton E. Brown and H. H. Schrenk. Bureau of Mines, Information Circular 7026; mimeographed.

**Preparation of Thin Sections of Coal,** by R. Thiessen, G. C. Sprunk, and H. J. O'Donnell. Bureau of Mines, Information Circular 7021; mimeographed.

**Oxidation of Anthracite: Effect of Time of Contact on the Concentration of Oxygen in the Effluent Gases,** by G. S. Scott and G. W. Jones. Bureau of Mines, Report of Investigation 3405; mimeographed.

**The Force Required to Move Particles on a Stream Bed,** by William W. Rubey. U. S. Geological Survey, Professional Paper 189-E; 10 cents.

**Water Levels and Artesian Pressure in Ground Waters, 1937.** U. S. Geological Survey document available for consultation in manuscript form. When published, probably many months hence, this will give a general summary for the United States of ground water supplies analogous to earlier water-supply papers.

**Publications of the Geological Survey, May 1938.** Printed document available from U. S. Geological Survey, Washington, D. C.

**Iron and Steel.** U. S. Tariff Commission, Report No. 128, Second Series; 60 cents.

**Federal Trade Commission Rules, Policy, and Acts, May 21, 1938.** Federal Trade Commission unnumbered document; 15 cents.

**Characteristics of Company Unions, 1935.** Bureau of Labor Statistics, Bulletin 634; 30 cents.

**Union Scales of Wages and Hours in the Building Trades in 70 Cities.** Bureau of Labor Statistics, Bulletin 657; 10 cents.

**Foreign Markets for Table and Kitchen Pottery.** Bureau of Foreign & Domestic Commerce processed document. Available only from Bureau of Foreign & Domestic Commerce, 10 cents.

**Review of United States Foreign Trade in Pulp and Paper, 1937.** Bureau of Foreign & Domestic Commerce processed document.

**Concrete Manual.** Bureau of Reclamation. This 454 page volume discusses fundamental principles of production of concrete and concrete structures. It is offered for sale by the Bureau of Reclamation, Washington, D. C., at $1.00 per copy. (Do not order through Superintendent of Documents.)

**Census of Manufactures.** Additional preliminary statistics for 1937 production, issued during August, include: chewing gum; cane sugar refining; corn syrup, corn sugar, corn oil, and starch; linseed oil, cake and meal; bluing; matches; essential oils; malt.

**Social-Economic Grouping of Gainful Workers of the United States 1930.** Census Bureau; 25 cents.

**Advertising in Sweden,** by Charles E. Dickerson, Jr. Bureau of Foreign & Domestic Commerce, Trade Information Bulletin 840; 10 cents.

**Animal and Vegetable Fats and Oils, 1933 to 1937.** Census Bureau; 10 cents.

**Process Patent Hearings.** Minutes of hearings before the Committee on Patents of the House of Representatives on H. R. 7851, considering proposed legislation to forbid importation of goods covered by U. S. process patents; 15 cents.

**Economic Conditions of the South.** Report prepared for the President by National Emergency Council. Available only from U. S. Information Service, 1405 G St., N.W., Washington, D. C.

**Spectral-Transmissive Properties and Use of Colored Eye-Protective Glasses,** by W. W. Coblentz and R. Stair. Bureau of Standards, Circular 421; 10 cents.

**Metallurgy.** Publications by staff of the National Bureau of Standards. Bureau of Standards, Letter Circular 522; mimeographed.

**Research on Wood, Cellulose, and Lignin,** by E. C. Sherrard. Forest Products Laboratory processed document. Available only from Forest Products Laboratory, Madison, Wis.

**Reaction of Hardwood Lignin with Hydrogen,** by E. E. Harris, James D'Ianni, and Homer Adkins. Forest Products Laboratory processed document. Available from Forest Products Laboratory, Madison, Wis.

**Sugar-Beet Culture in the Humid Area of the United States,** by J. G. Lill. Department of Agriculture, Farmers' Bulletin 1637; 5 cents.

**Regulations for the Enforcement of the Naval Stores Act.** (Revised). Department of Agriculture, Service and Regulatory Announcements, Naval Stores No. 1. Available from Flood and Drug Administration, Washington, D. C.

**A Portable Instrument for the Analysis of Hydrocyanic Acid Gas-Air Mixtures,** by R. J. Wilmot and T. N. Gautier. Reprint from Journal of Agricultural Research, Vol. 56, No. 4, Feb. 15, 1938; 5 cents.

**Methods for Manufacturing Acid-Precipitated Casein from Skim Milk,** by Charles S. Trimble and R. W. Bell. Department of Agriculture, Circular 279 (Revised April 1938); 10 cents.

**Production and Agricultural Use of Sodium Nitrate,** by Albert R. Merz and C. C. Fletcher. Department of Agriculture, Circular 436; 5 cents.

**Concentration of Low-Grade Magnesite Ores by Flotation,** by H. A. Doerner and Dwight L. Harris. Joint report of U. S. Bureau of Mines and Mining Experiment Station, Pullman, Washington. Available only from the State College of Washington, Pullman, Washington; 25 cents. (Do not order through Superintendent of Documents.)

**Minerals Yearbook, 1938.** Bureau of Mines, 1,339 pages, cloth bound; $2.00. Minerals resources data with statistics for the year 1937.

**Propane, Butane, and Related Fuels,** by E. R. Weaver. Bureau of Standards, Circular 420; 5 cents.

**A Study of Asbestosis in the Asbestos Textile Industry,** by Waldemar C. Dreesen et al. Public Health Service, Bulletin 421; 20 cents.

**Occupational and Environmental Analysis of the Cement, Clay, and Pottery Industries,** by R. R. Sayers, J. M. Dallavalle, and S. G. Bloomfield. Public Health Service, Bulletin 238; 10 cents.

**Metal Fume Fever and Its Prevention,** by R. R. Sayers, Public Health Service, Reprint 1953; 5 cents.

**Trading Under the Laws of Canada,** by Joseph H. Barkmeier. Bureau of Foreign & Domestic Commerce, Trade Promotion Series 176; 20 cents.

**Trading Under the Laws of Brazil,** by Henry P. Crawford. Bureau of Foreign & Domestic Commerce, Trade Promotion Series 183; 20 cents.

**Stories of American Industry (Second Series).** Department of Commerce unnumbered document; 20 cents.

**Know Your Coal.** Consumers' Counsel of National Bituminous Coal Commission, Consumer Ideas No. 3; 10 cents

**Composition of Coal Tar and Light Oil,** by C. H. Fisher. Bureau of Mines, Bulletin 412; 15 cents.

**Studies Pertaining to the Catalytic Hydrogenation of Pyrolytic Tars,** by Harold M. Smith, Harry T. Rall, and Peter Grandone. Bureau of Mines, Technical Paper 587; 10 cents.

**Electrometallurgical Investigations—Progress Report No. 23,** by J. Koster et al. Bureau of Mines, Report of Investigations 3406; mimeographed. This document reports on the work of the Bureau on electrolytic manganese, describes the installation of the electrometallurgical laboratory at Boulder City, Nevada, and of the Pullman, Wash., unit of the Bureau which is investigating magnesium.

**List of Respiratory Protective Devices Approved by the Bureau of Mines, with Supplement of August, 1938,** by H. H. Schrenk. Bureau of Mines, Information Circular 7030; mimeographed.

# Your Plant NOTEBOOK

## Safety in Cylinder Handling

*Editor's Note—The following notes on the "Safe Handling of Compressed Gases" are abstracted from the booklet of that title recently issued by the Compressed Gas Manufacturers' Association, 11 West 42d St., New York City. Certain rules of a general nature have been added to the general section and removed from the specific sections in which they occurred. Sections covering First Aid have been deleted, as has a short section dealing with tank cars. The complete booklet may be obtained from the Association.*

COMPRESSED GAS CONTAINERS are safe for the purposes for which they are intended. Serious accidents connected with their handling, use and storage can almost invariably be traced to abuse or mishandling.

The following rules compiled by Compressed Gas Manufacturers' Association are based upon accident prevention experience within these industries and should be observed in the handling of compressed gases. It should not be assumed, however, that every acceptable safety procedure is contained herein.

### General Rules

1. Never drop cylinders nor permit them to strike each other violently.

2. Never use a lifting magnet nor a sling (rope or chain) when handling cylinders. A crane may be used when a safe cradle or platform is provided to hold the cylinders.

3. When returning empty cylinders remove lower portion of the shipping tag attached to the cylinder. Bill of lading should specify number of cylinders, consignee and fact that the cylinders are empty. A copy of bill of lading should be sent to the consignee. Close valve before shipment. See that cylinder valve protective caps and outlet caps, if used, are replaced before shipping.

4. Only cylinders approved for use in interstate commerce should be used for the transportation of compressed gases.

5. Where caps are provided for valve protection, such caps should be kept on cylinders except when cylinders are in use.

6. Cylinders must not be filled except by, or with the consent of the owner, and then only in accordance with the regulations of the Interstate Commerce Commission.

7. Never attempt to mix gases in a compressed gas cylinder or other container intended for the transportation or storage of a compressed gas.

8. It is illegal to remove or change the numbers or marks stamped into cylinders without written authority from the Bureau of Explosives, New York City.

9. Never use cylinders for rollers, supports, or for any purpose other than to carry gas.

10. Never tamper with the safety devices in valves or cylinders.

11. Keep sparks and flames away from cylinders.

12. After removing the valve cap, slightly open the valve an instant to clear openings of particles of dust or dirt.

13. Open cylinder valves slowly.

14. If the valve is difficult to open, point the valve away from you and use greater force.

15. Never use wrenches or tools except those provided or approved by the manufacturer of the gas.

16. Avoid use of a wrench on valves equipped with hand wheels.

17. Never hammer the valve wheel in attempting to open or close the valve.

18. After attaching regulator and before the cylinder valve is opened, see that adjusting screw of regulator is released.

19. Before regulator is removed from a cylinder close the cylinder valve and release all gas from regulator.

20. Make sure that the threads on regulators, or other auxiliary equipment are the same as those on cylinder valve outlets. Never force connections that do not fit.

21. Regulators, pressure gages, hose and other appliances provided for use with a particular gas must not be used on cylinders containing different gases.

22. Never attempt to repair or alter cylinder or valves.

23. Cylinders should be protected against excessive rise of temperature. Cylinders may be stored in the open but in such cases should be protected against extremes of weather and from the ground beneath to prevent rusting. During winter, cylinders stored in the open should be protected against accumulations of ice or snow. In summer, cylinders stored in the open should be screened against continuous direct rays of sun.

24. No part of any cylinder containing a compressed gas should ever be subjected to a temperature above 125 deg. F. A direct flame should never be permitted to come in contact with any part of a compressed gas cylinder.

25. Never store cylinders near highly flammable substances such as oil, gasoline, waste, etc.

26. Cylinders should not be exposed to continuous dampness.

27. Store full and empty cylinders apart to avoid confusion.

28. Do not store cylinders near elevators or gangways, or in locations where heavy moving objects may strike or fall on them.

29. When in doubt about the proper handling of a compressed gas cylinder or its content, consult the manufacturer of the gas.

30. Be careful to protect cylinders from any object that will produce a cut or other abrasion in the surface of the metal.

### Oxygen

1. Never permit oil, grease, or other readily combustible substance to come in contact with oxygen cylinders, valves, regulators, gages and fittings.

2. Never lubricate oxygen valves, regulators, gages, or fittings with oil or any other substance.

3. Do not handle oxygen cylinders or apparatus with oily hands or gloves.

4. Never use oxygen from a cylinder without reducing the pressure through a regulator suitable for this purpose.

5. Where oxygen cylinders are connected to manifold or headers, such manifolds must be of proper design and equipped with one or more pressure regulators. Oxygen manufacturers will be glad to furnish specifications for construction and installation of proper oxygen manifolds and pipe lines.

6. Fully open the cylinder valve when cylinder is in use.

7. Never use oxygen as a substitute for compressed air. It is dangerous to use oxygen for pneumatic tools, to start diesel engines, for imposing pressure in oil reservoirs, for paint spraying, for blowing out pipe lines, etc.

8. Do not refer to oxygen as "Air." Call it by its proper name, "Oxygen."

9. Do not store cylinders near flammable material, especially oil, grease, or any substance likely to cause or accelerate fire. Oxygen is not flammable, but supports combustion.

10. Do not store reserve stocks of cylinders containing oxygen with reserve stocks of cylinders containing combustible gases. They should be separately grouped.

11. Do not allow oxygen cylinders to stand under line shafting or other places where oil can drip on the cylinder, its valves or other attachments.

12. In welding shops and industrial plants using both oxy-acetylene and electric welding apparatus, care should be taken to avoid the handling of these equipments in any manner which may permit the compressed gas cylinder to come in contact with electric welding apparatus or electrical circuits.

### Acetylene

1. Acetylene cylinders should not be used or stored in any position other than an upright position, to avoid possibility of drawing out acetone.

2. Acetylene should never be used at a pressure exceeding 15 lb. per sq.in.

3. Never use acetylene from cylinders through blow-pipes or other devices equipped with shut-off valves on the acetylene supply connections without reducing the pressure through a suitable regulator attached to the cylinder valve.

4. Be sure that all connections are tight and remain so and that the hose is in good condition.

5. Never attempt to transfer acetylene from one cylinder to another nor to mix any other gas with it in the cylinder.

6. Never use manifolds for acetylene cylinders unless constructed upon the advice of a qualified acetylene engineer, and complying with the standards of a recognized safety authority, such as Underwriters' Laboratories, Inc., the Associated Factory Mutual Fire Insurance Cos., etc.

7. The wrench used for opening the cylinder valve should always be kept on the valve spindle when cylinder is in use.

8. When returning empty cylinders see that valves are closed to prevent evaporation of acetone.

9. Never under any circumstances attempt to refill an acetylene cylinder.

10. The pressure in an acetylene cylinder does not accurately indicate the amount of gas contained therein. The amount is determined by weight (14.5 cu.ft. per pound).

11. Never test for acetylene leaks with an open flame. Use soapy water.

12. Use only acetylene generators manufactured by experienced companies and meeting all of the requirements of recognized safety authorities. "Homemade" acetylene generators should never be used.

13. Do not store reserve stocks of cylinders containing acetylene with reserve stocks of cylinders containing oxygen. They should be separately grouped.

14. In welding shops and industrial plants using both oxy-acetylene and electric welding apparatus, care should be taken to avoid the handling of these equipments in any manner which may permit the compressed gas cylinders to come in contact with electric welding apparatus or electrical circuits.

### Combustible Gases (Such as Hydrocarbon Gases, Hydrogen, Methyl Chloride, etc.)

1. Connections to piping, regulators and other appliances should always be kept tight to prevent leakage. Where hose is used it should be kept in good condition.

2. Never use an open flame to detect combustible gas leaks. Use soapy water. During freezing weather linseed oil may be used.

3. When cylinders are not in use, keep valves tightly closed.

4. Combustible gas cylinder pressures should be reduced preferably through a pressure regulator attached directly to the cylinder.

5. Manifolds for combustible gases should be used only if they are designed by qualified engineers. Gas manufacturers will furnish specifications for construction and installation of suitable manifolds.

6. Store all cylinders containing combustible gases in a well ventilated place.

7. Do not store reserve stocks of cylinders containing combustible gases with cylinders containing oxygen. They should be grouped separately.

### Carbon Dioxide

1. If it is necessary to immerse a cylinder in a bath of warm water to facilitate discharge, care must be taken to assure sufficient discharge at all times, to prevent a dangerous pressure in the cylinder. The temperature of the water bath should never exceed 125 deg. F. In no event should the cylinder valve be submerged nor more than 20 per cent of the surface area of the cylinder be under water.

2. Great care should be taken to avoid the backing up of water into the cylinder —particularly during the winter on account of the danger of freezing—or the entry of any foreign matter, such as oil, into or around the valve.

3. Never use carbon dioxide from cylinders in bottling plants, soda fountains, or for similar uses, without reducing the pressure through a suitable regulator attached directly to the cylinder. No precaution is more important than this.

4. Before attaching the pressure regulator to the cylinder, open slightly and close the cylinder valve in order to make sure of its easy operation, thereby avoiding damage to regulator by an outrush of gas from a suddenly opened valve.

5. As soon as the cylinder is empty and disconnected, the outlet cap, if used, should be replaced immediately on the outlet connection of the valve, in order to prevent damage to the threads on the outlet connection.

6. Store cylinders in a dry place when possible. Rusting causes the caps to stick and will give trouble.

### Sulphur Dioxide

1. If it becomes necessary to warm the cylinder to promote more rapid discharge, extreme care should be taken to prevent temperature above 125 deg. F. The fusible plugs in the containers melt at about 170 deg. F. and soften at a lower temperature. Never permit live steam to blow on the cylinders or the fusible plug safety devices. Never apply a direct flame against a cylinder.

2. Leaks may be detected by passing a rag dampened with aqua ammonia over the suspected valve or fitting. White fumes indicate escaping gas.

3. Every precaution should be taken to avoid drawing liquids back into containers as their contents is exhausted. To avoid this close the valve immediately after the container has been emptied.

4. Masks should always be readily available in places where sulphur dioxide is used.

5. Cylinders should be stored in an upright position.

### Chlorine

1. The heating of chlorine cylinders should be discouraged.

2. If it becomes necessary to warm a cylinder extreme care should be taken on account of the low fusion point (157 deg. F.) of the fusible metal safety devices in the valve or in the head of the "ton container." Never permit live steam to come in contact with these fusible safety devices. Never permit the valve to be heated.

3. Masks should always be readily available in places where chlorine is used, and so located as to be easily reached by the operator in case of need. Masks should be of a type approved by the U. S. Bureau of Mines for chlorine service.

4. Chlorine should be used only by experienced and properly instructed persons.

5. Use auxiliary valves and gages designed solely for chlorine use and then only after consulting the owner of the cylinder in the manner of this exacting service.

6. Cylinders should be stored and used in an upright position.

### Anhydrous Ammonia

1. A cylinder of ammonia should never be connected to an ammonia refrigerating system except when the system is being charged or drained.

2. Should it become necessary to withdraw ammonia from a refrigerating system into cylinders, care should be taken to avoid overcharging of such cylinders.

(*Please turn to page 568*)

# Process Equipment NEWS

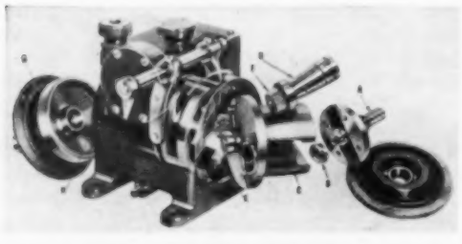
## Machinery, Materials and Products

### Variable Speed Transmission

ACCORDING to a recent announcement, new models of the Graham variable speed transmission which incorporate important additional features have been introduced by Graham Transmissions, Inc., 2711 North 13th Street, Milwaukee, Wis. Fundamental operating principles of the earlier transmissions are retained (see *Chem. & Met.*, Jan., 1937, p. 39), with the important addition of a positive non-slip feature which is said to maintain full torque over the entire speed range down to zero. According to the manufacturer, this feature has never before been attained in any type of variable speed transmission.

The new transmissions are capable of giving infinite speed variations at the output shaft, either forward or reverse, from about 1/3 motor speed to zero. In the accompanying disassembled view, power is applied by *A* and *B* to a carrier *C* in which are tapered planetary rollers *D* carrying planetary pinions *F*. A stationary driving ring *E* in contact with the rollers, can be moved lengthwise to vary the speed ratio. The carrier rotates at motor speed and the rollers at a speed dependent on the speed ratio. The cam *B* not only drives the carrier but at the same time applies an outward pressure to the rollers in proportion to the torque. This pressure brings the rollers into driving contact with the ring *E* so that the leverage of the pressure applied at the cam increases automatically as the output speed approaches zero.

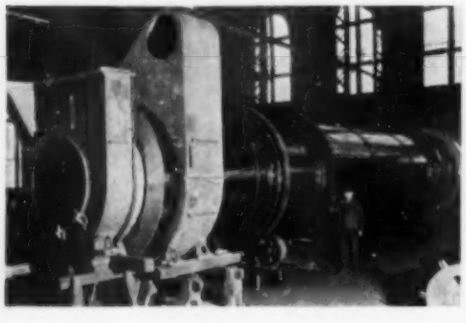
Improved variable speed transmission



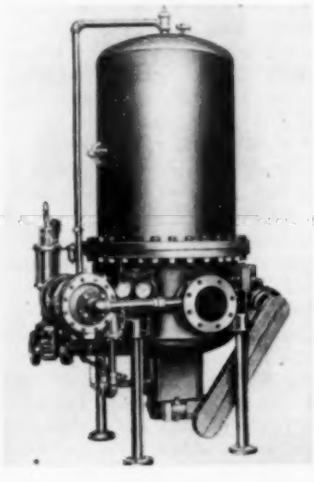
### Dustless Dryer

ELABORATE and expensive dust collecting equipment is said to be unnecessary with the new Type XB Ruggles-Cole dryer that has recently been announced by the Hardinge Co., York, Pa. This dryer, for pulverized and lump materials such as chemicals, clays, silica and abrasives, attains dustless operation by not allowing the products of combustion, nor large quantities of air, to come into contact with the product. This feature is desirable from both the standpoints of employee health and efficiency, and the saving of valuable material. The manufacturer states that cost comparisons have shown that the installed cost of the new dryer is considerably less than that of conventional single shell dryers of equivalent capacity provided with the usual dust control equipment.

New Type XB rotary dryer



New wire-wound backwashing filter



### Self Cleaning Filter

CUNO ENGINEERING CO., Meriden, Conn., has announced a new self-cleaning filter of the wire-wound type, especially designed for the removal of fine dirt and sand from river water. The filter features extremely low pressure loss, and no loss of water for backwash purposes. Cleaning is continuously accomplished by slowly rotating the wire-wound cartridge past a stationary backwash nozzle so that each portion of the surface encounters a momentary reversal of flow to dislodge the accumulated solids. The backwash water is obtained from a portion of the filtrate and is returned to the system. In the filter illustrated a hydraulically operated automatic dumping valve opens at predetermined intervals to allow blow-off of the sludge. It will be noted that the unit is self-contained, with all accessories mounted on the filter base to permit ready removal of the upper shell for inspection of the cartridge.

### Pressure Responsive Control

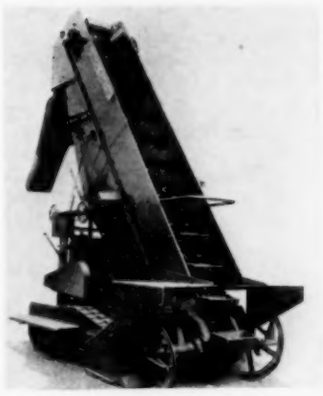
FOR USE with the Vari-speed Motordrive variable speed transmission which it manufactures, the Reeves Pulley Co., Columbus, Ind., has announced a new fluid pressure responsive control which can be added to the transmission so as to adjust the speed ratio, and hence the speed of the driven machine, in proportion to the pressure on the control bellows of the device. Thus the drive can be used on a pump to adjust the speed so as to maintain constant pressure in a line or tank, or it can be used to maintain constant boiler pressure by regulating the stoker speed. Among the other

Vari-Speed Motodrive with fluid pressure control

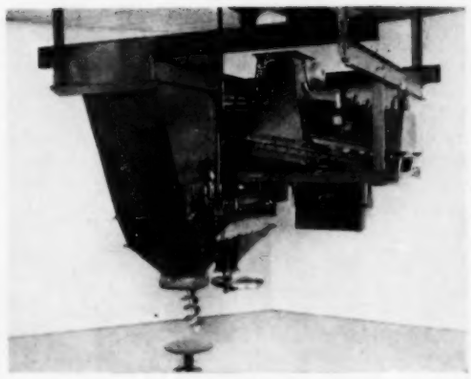
uses suggested is employment of the device for remote manual control of the speed ratio. A bellows attached to the shifter mechanism replaces the usual manual handwheel control. Pressure may be applied to the bellows by any suitable fluid such as air, water, oil, gas or steam.

## Bucket Loader

AUTOMATIC LOADING of a variety of bulk materials is the function of the new Junior Model 552 self-feeding bucket loader recently announced by the Barber-Greene Co., Aurora, Ill. The machine is crawler mounted and hence quickly movable from one point to another. Having self-feeding spirals, it operates continuously, at very low cost, according to the manufacturer. Special features include a tank-type chassis frame, automatic overload release and a boom which can be laid back for low traveling clearance.



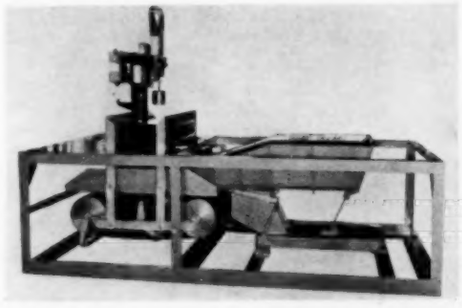
New Junior bucket loader



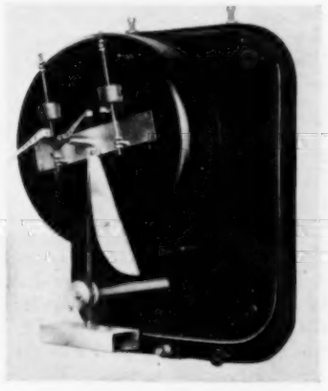
New Type 1 Risco packer

## Weigh Feeder

A RECENT DEVELOPMENT in the line of automatic feeding and weighing equipment put out by the Syntron Co., Homer City, Pa., is a continuous weigh feeder, designed to produce an accurately controlled steady flow of dry materials such as chemicals or coal. The machine consists of a combination of vibratory feeder conveyor and a constant-speed belt conveyor suspended from a scale operating sensitive electric valves, the latter controlling the rate of discharge of the vibratory mechanism which feeds the belt. Thus the scale serves only for weighing, as it exerts no mechanical power in operating the electric valves. A high order of accuracy is therefore maintained, according to the makers, in machines ranging in capacity from 25 lb. to 25 tons per hour.



Electrically operated continuous weigh feeder



Ring-balance flowmeter

## Packing Equipment

SEVERAL new models of packing equipment have recently been developed and announced by the Richardson Scale Co., Clifton, N. J. The Risco system of packing is built around a patented design of auger which has packing expanders at the foot, so designed as to pack outward as well as down. Spinning at speeds as high as 1,750 r.p.m. for some uses, the auger takes the air out of the material before it enters the container and drives it with sufficient force to give the maximum optimum density of packed material. With one type of packer the manufacturer reports that a saving of 11 in. in the height of a 50-in. bag was accomplished in a particular application.

Four designs of packer have been developed thus far. Type 1 is used for non-aerated materials which tend to pack themselves, while Types 2 and 3 are recommended for aerated materials. Type 1 packs bags and drums in a vertical position, as does Type 2, while Type 3 packs a bag supported horizontally. Type 2 packs the material in a tube surrounding the auger, squeezes out the air, returns the air to the supply hopper and discharges the deaerated material to the container. Type 3, however, for materials which tend to re-aerate quickly, packs directly into the container. All of these types incorporate a scale for weighing either before or after deaeration, while Type 4, consisting of a packer alone, employs no scale.

## Ring Balance Meter

FOR THE MEASUREMENT of gases at operating differentials as low as 2 in. w.g., and at pressures below those for which the customary types of mercury sealed flowmeters are suitable, the Cochrane Corp., Philadelphia, Pa., has developed a ring-balance meter in which water, oil or other suitable liquid is used for sealing. The meter consists of a ring-shaped hollow body, rotably mounted on knife edges at its center. The annular body is divided at the top by a partition, to each side of which a flexible tube is led for subjecting the unit to the differential pressure from an orifice or flow nozzle. Transfer of liquid from one side to the other owing to the differential pressure causes the ring balance to rotate and attain a new position of equilibrium. Direct proportionality of balance position to flow is attained by use of a suspended weight and cam as shown in the illustration. High accuracy and exceptionally high operating power for low pressure gas measurement are among the important features claimed for the instrument.

## Equipment Briefs

A NEW DESIGN of transformer-type arc welder with a leading power factor to assist in correction of the over-all plant power factor has been put on the market by American Transformer Co., 178 Emmet St., Newark, N. J. The open circuit voltage is so low as to make any hazard to the operator remote, while the potential available for maintaining the welding arc is high. Current control is described as especially smooth. The machine is compact and readily portable, and is claimed to be quieter and lower in operating cost than either motor-generator welders or the usual transformer types. This concern has also developed a small transformer known as the UL which is used for stepping down the high voltage supplied to equipment motors to operate one or more individual lights for the machine. Separate lighting circuits are thus avoided, light can be had where needed, and by using low voltage lamps, petty thefts can be prevented. Transformers for 115–575 volts supply can be had, for output ranging from 6 to 115 volts.

FOR PUTTING a protective and reinforcing metal edge on gaskets of any soft material which may be cut and finished on the job, the Azor Corp., Newark, N. J., has developed a channel-shaped flexible reinforcing strip made from copper or

other suitable metals. This strip has serrated edges and preformed teeth and is fitted around gasket openings after the gasket has been cut. No special tools or skill are required. The necessary quantity of edging material, which is known as Bindedge, is cut from a coil as required and is readily formed around sharp corners and irregular outlines. Application of pressure in installing the gaskets imbeds the teeth firmly.

A NEW TYPE of insulated industrial curtain wall for steel frame factory buildings has been announced by Johns-Manville, 22 East 40th St., New York, N. Y. The curtain walls consist of an application of 1-in. insulating board encased in ⅛-in. flat Transite or asbestos board, over which is applied a wall of corrugated Transite. The composite is non-combustible and is said to have an insulating value as great as a 14-in. thickness of common brick. Available in large sheets, the material is supported on the steel framework of the building by cadmium-plated bolts and the joints caulked. Special tools are not required.

TO ASSURE uniformity in the drawing up of bolts in flanges and cylinder heads, the Bonney Forge & Tool Works, has introduced a new tool known as the No. 66 torque-indicating wrench. The manufacturer claims that the accuracy of the torque-measuring mechanism is greater than the consistent performance of the bolts on which the wrench is used. The wrench is provided with a small head for use in normally inaccessible places. The ratchet mechanism clicks sharply and locks when the desired torque is reached, thus making it unnecessary to watch the indicator. The desired torque can be set in pounds and readily changed when desired.

FOR MOVING packaged material on a greater degree of incline than is normally encountered in regular conveyor work, U. S. Rubber Products, Inc., 1790 Broadway, New York, N. Y., has introduced a crepe-finished package conveyor belt. The belt was developed after careful study to determine the type of surface providing the best holding qualities in incline service. It is made in 28-oz. and 32-oz. duck with the special crepe finished cover on the carrying side.

IN RECENT YEARS it has become increasingly evident that marked protection against heat exhaustion may be provided for workers in hot locations by supplying them with salt tablets, available near the drinking fountain. Morton Salt Co., Chicago, Ill., has recently developed a new salt tablet dispenser for this purpose in which the tablets are kept dry and dust-free until used. The dispenser holds 1,500 ten-grain tablets which are easily released, one at a time, by flipping a small lever at the base of the dispenser.

FOR USE in a wide variety of applications, the Chicago Metal Hose Corp., Maywood, Ill., has announced a one-piece bellows produced from thin-walled stainless steel by a new process developed by the company's engineers. The bellows is formed by seam-welding thin stainless steel strip into tubing and by rolling the tubular form into the finished bellows. The metal is spun both inwardly and outwardly from the mean diameter of the straight tube, a method which is said to assure maximum uniformity of thickness and greatest inherent strength and flexibility. Stainless steel is stated to be much superior to brass.

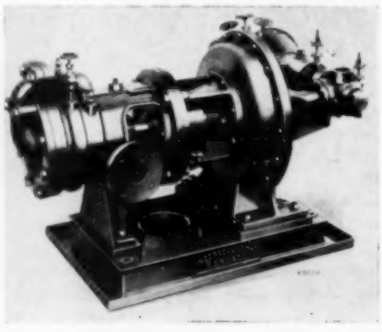
AN IMPROVED pH meter for use with glass electrodes of any commercially available type has been announced by the Wilkens-Anderson Co., 111 North Canal St., Chicago, Ill. The Cameron pH meter, which was developed by the same inventor as the Cameron pH recorder previously announced, is of the continuously indicating potentiometric type, with an electrical circuit accuracy said to be within 0.02 pH, giving results easily within the 0.05 pH differential generally required. Sustained accuracy, more convenient operation and greater flexibility are important claims for the new meter.

## Turbine Driven Pump

UNIQUE CONSTRUCTION whereby a turbine is utilized to drive a centrifugal pump mounted on the same shaft is available in the new class TRV single- and two-stage pumps manufactured by Ingersoll-Rand Co., 11 Broadway, New York, N. Y. Single-stage pumps are built in capacities from 5 to 1,000 g.p.m. against heads up to 220 ft., and two-stage pumps in sizes for capacities to 275 g.p.m. and heads up to 550 ft.

The unit assembly of pump and turbine is stated to make possible substantial reduction in weight. A 15-hp. single-stage unit is only about 32 in. long and other sizes proportionately small. Special foundations are not required and units are available for operation in any position, bolted to the floor, wall, a column or the ceiling. When steam is not available, the turbines are stated to operate satisfactorily on compressed air.

**Close-coupled turbine-driven pump**



## High Temperature Fan

HIGH-TEMPERATURE application is the field for a new line of fans developed by the Michiana Products Corp., Michigan City, Ind. These fans are recommended for the handling of hot gases or products of combustion in heat conservation systems and are stated to embody novel principles of design and construction, making them capable of operating at temperatures up to the limit of the heat-resistant alloys used in their manufacture. Fans for temperatures from 800 to 1,800 deg. F. are available.

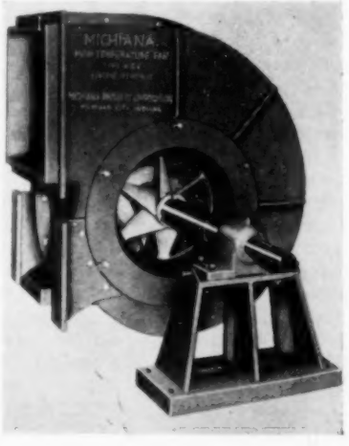
## Sight Flow Indicator

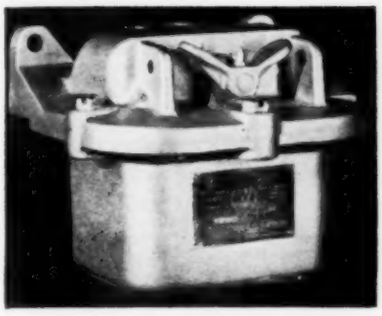
FOR DETERMINING whether or not fluid is flowing through a pipe line, the Fischer & Porter Co., 110 West Penn St., Germantown, Philadelphia, Pa., has introduced a new bull's eye sight flow indicator of especially rugged construction, employing bolted cover plates for securing windows on both sides of the indicator. Between the windows is a flapper suspended in such a manner as to swing outward and upward as soon as flow commences. Neoprene or Thiokol packing is used. Sizes range from ½ in. to 3 in. pipe size. Special construction materials are available in addition to the cast iron, bronze, and aluminum which are standard.

## Safety Pushbutton Station

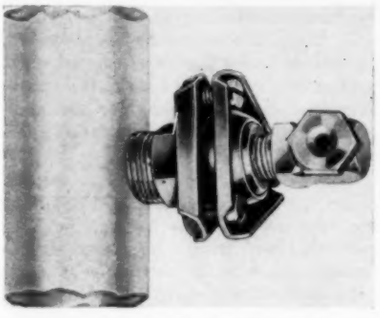
A NEW LINE of heavy duty Type HD pushbutton stations for use in corrosive atmospheres and in Class I Group D hazardous locations has been designed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These devices are built in accordance with Underwriters' Laboratories requirements and are explosion proof, either with or without oil in the case. They are available with from one to four standard pushbutton units, for either momentary or maintained contact. Cast iron is used for the exposed portions, with bolts, shafts and fittings

**Fan for high temperature use**





Explosion-proof pushbutton station



New adjustable spray nozzle

of a corrosion-resisting copper alloy. In addition, two- or three-position selector switches are available, either as single-pole, double-throw switches, or double-pole, single-throw switches.

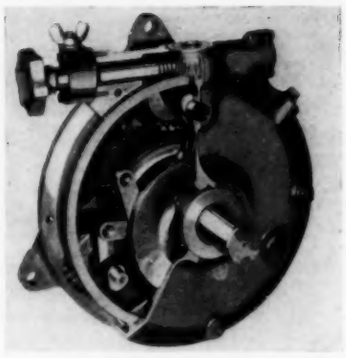
## Improved Spray Nozzles

SPRAYING SYSTEMS CO., 4922 West Grand Ave., Chicago, Ill., has announced two new developments in spray nozzles, including a line of "Whirljet" non-clogging nozzles and new nozzles of adjustable construction. The Whirljet nozzle produces an evenly distributed hollow cone spray and is available in various types, in sizes from ⅛ to 2½ in., for capacities from 0.1 to 107 g.p.m. at 10 lb. pressure. Adjustable nozzles employ a spherical joint for changing the angle with respect to the pipe and are made in sizes ranging from ¼ x ⅛ in. to ½ x ⅜ in. Both types are regularly made of brass but can be had in other materials as required to meet specific chemical and corrosive conditions.

## Variable Speed Control

WHAT IS DESCRIBED as a simple, positive mechanism for governing the speed of output shafts through an infinite number of variations within the range of the unit is the new variable speed control recently announced by the Morse Chain Co., Ithaca, N. Y. With the input shaft operating at the recommended speed of 180 r.p.m, the control can quickly be adjusted by a hand set with visible dial to deliver from 1½ to 40 r.p.m. to the low speed shaft.

The cutaway view shows that the input shaft is constructed with an integral cam against which hardened and ground rollers of alloy steel operate. From the rollers the driving action is transmitted through links to three of this company's high-torque clutches which operate with a ratcheting movement, rotating the pinion gears which in turn drive the mating gear which is integral with the low speed shaft. Speed adjustment is made by varying the eccentricity.



Cutaway view of variable speed control

The new unit is recommended for the operation of feeders, conveyors and other equipment needing variable speed drive. As it is self-contained it is said to be unaffected by dust and dirt.

## Particle Sizer

A RECENT ANNOUNCEMENT of the Colloid Equipment Co., 50 Church St., New York, N. Y., describes the new Palo-Travis particle sizer, which is an instrument for the measurement of particle size below 325 mesh. The development of Pierce M. Travis and based on a modification of the Werner apparatus, the new instrument employs a sedimentation method which is said to yield high accuracy with speed and ease of manipulation. A representative sample of 5 grams is all that is required, with results obtained in about two hours. Plant control operatives are stated easily to master the operation of the sizer.

The instrument has a sedimentation tube about 1 m. in height in which the sample is allowed to settle in a suitable liquid medium, the specific viscosity of which is known in relation to water. The height of the sediment is then read at intervals by means of a micrometer eyepiece and from the measurements in relation to time the theoretical radii of the particles are calculated.

## Automatic Batch Weigher

DEVELOPMENT of a complete new line of automatic batching scales has been completed by the Buffalo Scale Co., Buffalo, N. Y. The line offers a wide range of flexibility and adaptability for varying production requirements. For example, batching scales are available for manual operation or with electric eye and interlocking sequence controls. If desired, a full automatic cycle without attendance can be secured. In the automatic and semi-automatic models, cut-off is accomplished by two electric eyes, the first of which anticipates the correct weight and cuts down the flow to a dribble, while the second cuts off at exact weight. It is claimed by the manufacturer that consistent accuracy within better than 0.1 per cent can be attained on both the individual ingredients and the total batch. In certain of the models, sequence controls are employed so that ingredients are weighed in always in proper rotation. Should the supply of one ingredient fail, operation will stop automatically.

# MANUFACTURERS' LATEST PUBLICATIONS

**Air Conditioning.** Carrier Corp., Syracuse, N. Y.—12-page catalog with brief descriptions and engineering data covering a wide variety of equipment for industrial air conditioning, refrigeration and space heating.

**Burners.** Thermal Processes, Inc., 405 East Oliver St., Baltimore, Md.—Bulletins B-100-900—Group of five bulletins covering a variety of types of oil burner including manual air-adjusting, mechanical atomizing, automatic air-adjusting, manual air-adjusting steam and water-cooled mechanical; also steam-oil mixers for use with burners.

**Chemicals.** Carbide and Carbon Chemicals Corp., 30 East 42d St., New York City—Chemical Group Folder No. 6—Describes applications and properties of 14 synthetic ketones which are used as industrial solvents and intermediates.

**Coatings.** Technical Protective Coatings, Inc., 3248 Long Beach Ave., Los Angeles, Calif.—28-page "Encyclopedia of Corrosion Prevention," covering this company's rubber-base and other finishes for concrete, metals, etc.

**Compressors.** Sullivan Machinery Co., Michigan City, Ind.—Bulletin A-22—20 pages describing this company's stationary and semi-portable air compressors in capacities to 435 c.f.m. and 125 lb. per sq. in. pressure.

**Disintegration.** Traylor Engineering & Mfg. Co., Allentown, Pa.—Bulletin 2112—22 pages with description and engineering data covering this company's Type TY reduction crusher.

**Electrical Equipment.** Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Booklet F. 8450—8 pages on dry boric-acid power fuses for protection of high voltage circuits and equipment.

**Engines.** Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin S-500-B35—Describes and gives complete specifications of a new line of diesel engines for industrial plants and general power users, developed by this company and introduced under the designation BB.

**Equipment.** Eclipse Air Brush Co., Newark, N. J.—32-page catalog covering this company's spray equipment, including spray guns and accessories, air-operated agitators, spray booths and exhaust equipment, compressors and other devices for finishing.

**Equipment.** The Elliott Co., Jeannette, Pa.—Bulletin C-8—24 pages with descriptions and detailed engineering in-

formation on this company's surface condensers. Also Bulletin H-11, 4 pages describing this company's Type BY turbines for mechanical drive.

**Fire Protection.** Walter Kidde & Co., 140 Cedar St., New York City—Bulletin D-495—4 pages on this company's carbon dioxide-operated water and antifreeze portable fire extinguishers.

**Instruments.** The Bristol Co., Waterbury, Conn.—Bulletin 515—24 pages covering this company's Metameter system of telemetering, with information on remote measurement and automatic control of pressure, vacuum, liquid level, temperature and other variables.

**Instruments.** The Foxboro Co., Foxboro, Mass.—Bulletin 208—8 pages describing in detail this company's recording pressure gages.

**Instruments.** Mason-Neilan Regulator Co., 1190 Adams St., Boston, Mass.—Bulletin 2345-A—26-page catalog describing this company's air-operated controllers for temperature, pressure, flow and liquid level, with information on a new remote manual control available with these controllers.

**Instruments.** C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y.—Catalog 1060D—4-page bulletin describing in detail a new line of pressure-spring direct-set indicating controllers for temperature and pressure.

**Instruments.** Thwing-Albert Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.—Bulletin M-382—4 pages briefly illustrating the range of instruments made by this company for measuring and controlling temperature and for paper testing.

**Lighting.** Lighting Division, Westinghouse Electric & Mfg. Co., Cleveland, Ohio—Catalog Section 61-153—4 pages describing Locklite reflectors and hoods for industrial lighting, complete with tabular information.

**Lubrication.** The Texas Co., 135 East 42d St., New York City—42-page booklet on the lubrication of ball and roller bearings, with information on bearing construction, types of lubricants, and the requirements of various types of bearings. Information is also given on grease and oil seals, together with recommendations for specific applications.

**Metals.** Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill.—Pocket-size 1939 stock list covering a wide range of certified steels and allied products carried in stock by this company; includes structural shapes, plates, bars, strips, tubing and other items.

**Mixers.** Robinson Mfg. Co., Muncy, Pa.—Catalog 32-E—56-page catalog on this company's Unique and Gardner mixers for powders, semi-solids and liquids. Many types are described, with specifications.

**Ply Metals.** Lukens Steel Co., Coatesville, Pa.—Vol. 1 No. 1 of "Clad News," a new periodical leaflet dealing with the applications of nickel and nickel-alloy-clad steel.

**Power Transmission.** D. O. James Mfg. Co., 1120 West Monroe St., Chicago, Ill.—Catalog 150—175-page catalog with descriptions and engineering data covering this company's standardized stock speed reducers and flexible couplings, with tables of useful information.

**Pumps.** Blackmer Pump Co., Grand Rapids, Mich.—Leaflet describing a new quick-demountable sanitary positive displacement pump, designed for easy cleaning.

**Pumps.** Roots-Connersville Blower Corp., Turbine Pump Division, Connersville, Ind—Form L-14D—Price list applying to this company's boiler service equipment, including condensate return, boiler make-up and condensate return, and direct boiler feed supply systems for boilers from 7½ to 500 hp. capacity.

**Refractories.** Atlas Lumnite Cement Co., Chrysler Bldg., New York City—6-page folder describing the properties of Lumnite and its application in the construction of stacks and chimneys.

**Refractories.** Ironton Fire Brick Co., Ironton, Ohio—4-page folder briefly describing properties of this company's firebrick.

**Rubber.** American Hard Rubber Co., 11 Mercer St., New York, N. Y.—Catalog 300-3—60 pages on this company's hard rubber equipment for process industry use, with information on linings, pipe and fittings, valves, pumps, buckets, blowers and exhausters, etc.

**Softeners.** International Filter Co., 59 East Van Buren St., Chicago, Ill.—Bulletin 1850—16 pages completely covering the question of hot-flow water softeners for boiler feed-water treatment.

**Traps.** W. H. Nicholson & Co., Wilkes-Barre, Pa.—Bulletin 938—4 pages describing a special float-operated trap for gasoline, with prices, dimensions, capacities and weights.

**Weighers.** Merrick Scale Mfg. Co., Passaic, N. J.—Bulletin 388—12 pages describing use of this company's Feedoweight automatic weighing feeder in a variety of applications.

## CYLINDER HANDLING

(*Continued from page 563*)

Only empty ammonia cylinders should be used for this purpose and in order to insure that they are empty, the valve should be opened and left open for five minutes prior to attaching them to the system which is to be emptied. The cylinder should then be placed on a scale and its tare weight noted. This tare weight should check closely the tare weight furnished by the cylinder owner and if there be any difference, the smaller of the two tare weights should be used. The cylinder can then be connected to the system, but should be weighed from time to time while filling and the amount charged should be no greater, and preferably less, than the weights given below:

| | |
|---|---|
| 150 lb. for cylinders | 7 ft.x12 in. dia. |
| 150 lb. for cylinders | 58 in.x15 in. dia. |
| 100 lb. for cylinders | 7 ft.x10 in. dia. |
| 100 lb. for cylinders | 56 in.x12½ in. dia. |
| 50 lb. for cylinders | 46 in.x10 in. dia. |
| 50 lb. for cylinders | 43 in.x10½ in. dia. |
| 40 lb. for cylinders | 42 in.x10 in. dia. |
| 25 lb. for cylinders | 28 in.x10 in. dia. |

3. If any cylinder be accidentally overfilled, allow the excess gas to escape immediately into water.

4. When cylinders are used to return withdrawn ammonia, customers should advise the gas manufacturer, giving identification numbers of the cylinders, so that such cylinders may be promptly weighed, examined and cleansed before being charged with pure ammonia.

5. Caps should be carefully attached to the cylinders when they are being returned; also plug in valve outlet should be properly inserted.

6. Ammonia cylinders of the ICC-4 type should be stored on their sides. All ammonia cylinders should be stored in a cool dry place.

### Dichlorodifluoromethane (Freon-12)

1. Should it become necessary to warm the cylinder to promote more rapid discharge, extreme care should be taken to prevent a temperature above 125 deg. F. as the fusible plugs in the cylinder and valve have a melting point of 157 deg. F. and soften at a lower temperature. Never permit live steam to blow on the cylinders or the fusible plug safety devices and never apply a direct flame against a cylinder or valve.

2. Every precaution should be taken to avoid drawing liquid refrigerant or oil into a cylinder when discharging the cylinder contents. The valve should be closed immediately after the cylinder has been emptied.

3. As soon as the cylinder is emptied of refrigerant, valve closed and cylinder disconnected from the system, the brass protection cap should be placed on the outlet connection of the valve so as to prevent dirt entering the valve and also to prevent damage to the threads on the valve connection. Cylinder hoods should be carefully screwed in place on the cylinder after use and before placing cylinder in stock or returning to manufacturer.

4. Should it become necessary to withdraw dichlorodifluoromethane from a refrigerating system into cylinders, care should be taken to avoid over-charging such cylinders. Only empty dichlorodifluoromethane cylinders should be used for this purpose and in order to insure that they are empty the valves should be opened and left open for five minutes prior to attaching them to the system which is to be emptied. The cylinder should then be placed on a scale and its tare weight noted. It is then ready to be connected to the system but should be weighed from time to time in order that not more than 145 lb. of the gas and oil be placed in each 145-lb. cylinder nor more than 25, 10 and 4 lb. of the refrigerant and oil in the cylinders of these sizes. The capacity of the cylinders may be ascertained from the following table:

| | |
|---|---|
| 145 lb. for cylinders | 48¼ in.x10¼ in. dia. |
| 25 lb. for cylinders | 21¾ in.x6¾ in. dia. |
| 10 lb. for cylinders | 26¾ in.x4 3/16 in. dia. |
| 4 lb. for cylinders | 11 in.x4 3/16 in. dia. |

5. Store cylinders upright and in a cool, dry place whenever possible. Keep cylinders away from salt or other corrosive chemicals or fumes as rusting will cause damage to the cylinders and cause the cylinder hoods to stick.

6. Leaks of a non-flammable and non-combustible fluorine-containing refrigerant may be detected by use of a Halide leak detector torch.

# Chemical Engineering NEWS

## A. I. Ch. E. to Meet At Philadelphia

The Quaker City, heart of one of the country's largest chemical industrial areas, will act as host to members of the American Institute of Chemical Engineers at their 30th annual meeting, November 9, 10 and 11. General headquarters for the meeting will be at the Benjamin Franklin Hotel.

The local committee, headed by Dr. James G. Vail of the Philadelphia Quartz Co., has planned a full program for the three days, including four technical sessions and two afternoons of plant visits which will take in the Pennsylvania Sugar Co., Surpass Leather Co., Scott Paper Co., Proctor & Schwartz Co., Lenox, Inc., Leeds & Northrup, and refineries of the Gulf, Atlantic, and Socony-Vacuum oil companies. There will also be inspection tours of the chemical engineering laboratories of Drexel and Franklin Institutes and the University of Pennsylvania.

Dr. George Vincent, eminent sociologist and educator, will be guest speaker at the banquet Tuesday evening. A feature of the technical program will be a symposium on chemical engineering economics which will be centered around papers presented by D. P. Morgan of Scudder, Stevens & Clark, and Charles M. A. Stine and Chaplin Tyler of E. I. du Pont de Nemours & Co.

Some of the 20 papers to be presented at the Applied Chemical Engineering sessions are: "Quantitative Determination of Industrial Gas Dispersoids," by E. Anderson, Western Precipitation Co.; "Performance of Commercial Perforated Plate Distillation Column," by J. G. Baker and R. C. Gunness, Standard Oil of Indiana; "Corrosion of Metals in the Soap and Allied Industries," by G. L. Cox, International Nickel Co., New York; "The Flow of Gases Through An Orifice Plate," by L. E. Stout and G. Russell, Washington University; "Mechanism of Drop Condensation," by H. Emmons; "Stainless Steels for Use in Chemical Equipment," by H. L. Maxwell; "Chemical Stack Losses From Soda Recovery Furnaces," by H. F. Gardner, University of Rochester, and R. P. Whitney, Massachusetts Institute of Technology. Also, there will be five papers on heat transfer coming from the laboratories of the University of Michigan, Cornell University, and Massachusetts Institute of Technology.

On Nov. 7 and 8 preceding the annual meeting, the national convention of A.I.Ch.E. student chapters will be held with headquarters at Houston Hall, University of Pennsylvania. The local chapter will be host to the visiting student engineers, and Prof. Norman W. Krase of the department of chemical engineering is in charge of program arrangements.

## M.C.A. Asks for Joint Hearings On Explosives Regulations

Manufacturing Chemists Association of the United States took the lead Oct. 1, in a movement fathered by various segments of the chemical industry for consolidating the hearings ordered by the ICC on regulations for transportation of explosives and other dangerous articles by private carriers, as well as the hearings on the regulations for qualifications of and maximum hours of services for employees of such operators.

It is asked in the petition that the ICC direct such a consolidated hearing be held in Chicago at a date to be set by the commission at some time after Jan. 1, next, so as to allow ample time for the preparation of data on the two main considerations.

It is of prime importance says the petition, that these proceedings be simplified as much as possible, and that the commission should treat them jointly as one. In the East the Commission has frequently granted such applications so far as holding hearings is concerned, while retaining the right to keep the decisions on the related subjects separate and independent.

## Acetylene Congress Will Be Held in Munich

The 13th International Congress of Carbide, Acetylene, Oxy-Acetylene Welding and Allied Industries will be held in Munich, Germany, from June 25 to July 1, 1939. The three preceding Congresses were held in Zurich in 1930, in Rome in 1934, and in London in 1936.

The purpose of the Congress is to promote and discuss all questions of scientific, technical, and economic nature which are related to the preparation and uses of calcium carbide, of acetylene, and of the oxy-acetylene process. Because of its importance for metal fabrication, the field of oxy-acetylene welding will receive special emphasis. The other related technical fields will also be given full attention, particularly the use of acetylene as the starting point in making chemical products.

## Tetrasodium Pyrophosphate Developed by Monsanto

Production of tetrasodium pyrophosphate on a commercial basis in sufficiently large quantities to supply the requirements of soap manufacturers has been attained by Monsanto Chemical Co., according to an announcement by R. F. Richard, general manager of sales, Phosphate Division.

Tetrasodium pyrophosphate—now tradenamed "Phosphotex" by Monsanto—has been in the process of development commercially for the last several years in Monsanto's research laboratories in Anniston, Ala., and Dayton, Ohio, and now is being produced in large tonnages as the joint effort of the Monsanto phosphate plants at Anniston and Columbia, Tenn.

## New Butyl Alcohol Plant In Puerto Rico

Production of butyl alcohol and acetone from molasses will be started in Puerto Rico as soon as a new plant now under construction has been completed. Financing of the new project has been arranged through the Puerto Rican Reconstruction Administration, a loan of $550,000 having been made by the Administration to the Asociation Azucarera Co-Operativa Lafayette of Puerto Rico. This association was formed to operate a sugar plant and the new venture is said to be a logical development to find an outlet for its surplus production. The new plant will have a capacity of approximately 3,500,000 lb. of butyl alcohol and 1,500,000 lb. of acetone. It will operate on the Arroyo patents owned by the Lummus Co., the builder of the plant.

## Directors Named for Herty Foundation Laboratory

Frank deC. Heyward, Jr., has been appointed field director and Dr. Charles H. Carpenter, technical director of the Herty Foundation Laboratory, Savannah, Ga., to continue the research in pulp and paper products development which had been carried on by the late Dr. Charles H. Herty.

## Petroleum Institute Will Meet in Chicago

Plans are being made for the 19th Annual Meeting of the American Petroleum Institute, scheduled for Nov. 14 to 18 next in the Stevens Hotel at Chicago. Outstanding speakers will appear on the program for the two general sessions to be held Wednesday and Thurday afternoon, Nov. 16 and 17. As usual, the first two days of the meeting will be given over to separate sessions of the Institute's many committees. Group sessions of the Division of Production and of Refining will be held Thursday morning, Nov. 17, and Friday morning and afternoon.

The first meeting of the Institute's board of directors is scheduled for Tuesday afternoon, Nov. 15. The board of councillors will meet Wednesday morning, to elect directors, who will be elected at the Wednesday afternoon general session. The annual banquet will be held Thursday night in the Grand Ball Room.

## Lalor Foundation Will Continue Fellowship Awards

The Lalor Foundation has announced the program for its third series of fellowship awards, authorizing grants to the total amount of $25,000 for the academic year 1939-40. The amount of each award will be determined on the basis of the previous training, demonstrated competence and promise of the candidate as respects his chosen field of work. Except under unusual circumstances, the amount of the individual award will range between $1800 and $2500.

Seven fellowships of the 1938-39 series are being currently administered by the Foundation, which was organized in 1935. The activities of the holders of present fellowship awards are in the fields of biochemistry, cryogenics, the chemistry of enzymes, photochemistry, and macro-molecular chemistry and the institutions at which the researches are being conducted are the University of Upsala, the University of Leipzig, Harvard University, Johns Hopkins University, the Massachusetts Institute of Technology, the University of Chicago and the University of California.

## International Congress Sought By Washington Chemists

Washington chemists have begun the solicitation of support for their plan to have the 1945 meeting of the International Congress of Chemistry in the Capital City. The next meeting of the organization will be held in London in 1941. Before that date chemical organizations in thirty-four countries will be supplied with reasons why the next meeting should be held in the United States.

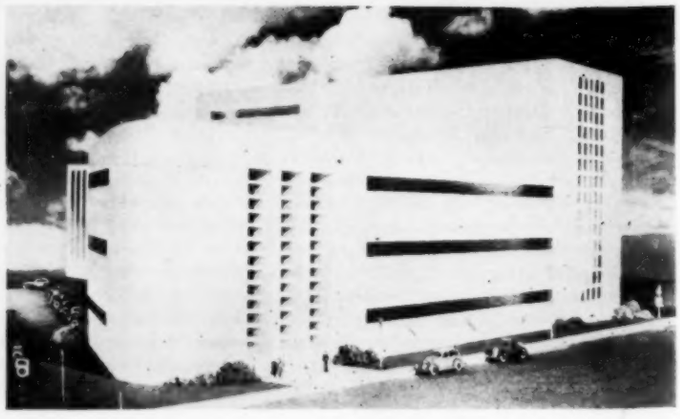
At the request of C. C. Concannon, chief of the Chemical Division of the Bureau of Foreign and Domestic Commerce, various government chemists are writing their personal friends in other countries in attempts to have them use their influence in behalf of Washington. During the winter it is planned to interest the various chemical societies in a more formal campaign.

## Organization Suggested for Users of Alcohol

James P. McGovern, general counsel for the Industrial Alcohol Institute, has suggested that the institute sponsor a movement to bring users of industrial alcohol into an organization for their mutual benefit. Mr. McGovern stated that in view of the enlarging and complicated prospective due to the present interest and concern of the several States in their problems of enforcement, I am convinced that our institute, powerful and willing as it is, can best serve the industry in all of its branches by allying itself with those groups of users within the industry who of necessity are dependent upon producers for their supply of alcohol, pure and denatured, as a chemical raw material.

---

**Views of two new research laboratories and a drawing of new modernistic chemical plant now in process of construction. Left—New research building of Abbott Laboratories at North Chicago, Ill., which was formally dedicated on Oct. 7. Upper Right—New Squibb institute for medical research at New Brunswick, N. J., which was dedicated on Oct. 11. Lower Right—Air-conditioned plant under construction at Syracuse, N. Y., for Church & Dwight Co.**



# NEWS FROM WASHINGTON

**Washington News Bureau**
**McGraw-Hill Publishing Co.**
**Paul Wooton, Chief**

WAR PROBLEMS in the relationship of government and business are foremost in the minds of industry spokesmen in the Capital. Whatever the immediate course of European affairs, both government and business representatives feel that every possible precaution must be taken to care for raw material supplies and other import needs of American industry. Those speaking for the mineral industry are particularly grieved that the purchase of strategic materials for American stock piles was not authorized by the last Congress. Fortunately, however, most of the commodities on such list are not chemical in nature though some of them are important to process industry.

The list of those commodities which might be cut off with serious effect on both non-military and military industry has shrunk very much during the last decade. Most of the commodities which remain to trouble American manufacturers are things like mercury and tin, for which domestic supplies are undoubtedly inadequate, and for which complete replacement in most applications is extremely difficult. Fortunately, many other minerals have been developed in this country on an adequate basis, so that either stock piles held commercially or new processes on domestic raw material could care for the United States needs quite readily, as in the case of vanadium, tungsten, chromium, and manganese (the latter two "at a price"). Even more abundant are, of course, nitrogen, potash, and iodine which American chemical industry can furnish without difficulty, in striking contrast with the World War days.

### Food and Drug Rules

Several regulations have been issued by Food and Drug Administration to give effect to the new Federal Food, Drug, and Cosmetic Act which is now in part in force. The full effect of the law will be reached June 25 of next year, but pending that time practically all of the old food standards will continue to govern operations. The most important of new regulations relate to the use of certain chemicals whose presence in foods, drugs, or cosmetics is believed to be hazardous to public health.

Initial actions of the Administration virtually forbid the use of a number of solvents such as diethylene glycol in material intended for internal consumption, di-nitro-cresol for certain cosmetics, and other like "hazardous" items which the officials think should be immediately taboo. Also the general distribution without medical control of very potent drugs like sulfanilimide will be definitely restricted. For the present this is not by formal order, but the official caution issued is likely to be almost as effective.

All manufacturers of cosmetics, drugs, and foods who use coal-tar dyes in these products are asked to submit promptly a list of those colors which they need for these purposes. It is expected that only certified dyes will be permissible after next June. Chief W. E. Campbell, therefore, warns that early cooperation of users of these colors is essential in order that adequate supplies of certified material may be available when the use of non-certified products becomes illegal.

### Alcohol Users Conference

There should be established some agency for conference among important groups of alcohol users outside the beverage industries. This is the essence of a proposal by James P. McGovern, general counsel of Industrial Alcohol Institute, a trade association through which alcohol producers cooperate. The objective of such a Council, according to McGovern, would be to discuss and make that cooperative effort which is needed to protect alcohol against unduly burdensome taxes and restrictive regulation. Such difficulties often burden ethyl alcohol as an industrial chemical through an overflow of zeal of regulatory officials whose prime objective is the control of alcoholic beverages.

No announcement has yet been made as to the technic of securing the establishment of such "Council of Industrial Alcohol Users." But it is expected that some of the Alcohol Institute officials will undertake to bring together either individuals or trade association spokesmen who could logically confer on common problems. As has been pointed out editorially by *Chem. and Met.*, there are many such common tasks in which users of alcohol must take an active part in order to prevent prohibitive burdens being imposed on those who have as users only non-beverage interest. Producers working alone are not able to defend this commodity adequately against the varied and persistent attacks which it suffers in state legislatures and in Washington.

Experimental manufacture of various papers to determine the factors which limit the life of paper for records has been carried out in the semi-works paper mill of the Bureau of Standards. Various rag and wood fiber writing papers were made with various beater-sizing materials like alum, rosin, and starch, and with various surface-sizing types using glue and starch. Similarly book papers with various common fillers have been made, including clay, titanium pigments, zinc pigments, and chalk or precipitated calcium carbonate.

"This work showed, as have likewise extensive tests of commercial record papers, that the stability of such papers as found by accelerated aging by heating, is dependent mainly on the cellulosic purity of the fibers and the degree of acidity of the papers. Very stable papers were made from the higher grades of both rag and wood fibers, when the acidity imparted by alum was not excessive. Of the other sizing materials used, rosin had a minor deteriorative effect. No adverse effect on stability was found for starch, and glue surface-sizing improved the stability of the less-stable papers. None of the fillers used for the book papers affected their stability, and that of the less-stable papers was appreciably improved by calcium carbonate."

### News "Fines"

Lead Tolerance—Recommendations of the Public Health Service to the Department of Agriculture have resulted in an increase in the quantity of lead residue which is permitted in fruits and vegetables. Formerly any material was subject to seizure that contained more than 0.018 grain per pound; but the new regulations permit up to 0.025, which P.H.S. investigation finds will not "be sufficient to endanger the health of the consumer." The new regulations greatly assist those who desire to use lead arsenate more generously as an insecticide.

Linting Test of Paper—A new technic for determining whether paper will too readily form lint has been devised by the Bureau of Standards for controlling government purchases of teletype paper. A series of sealing waxes is used, with varying order of adhesiveness. Paper which will not lint under a number 10 wax is good, but one which will lint with number 8 wax forms too much fuzz for clear printing of the teletype. Similar test procedures would presumably apply to papers for other uses where lint is significant.

Hazardous Packing—Government officials are warning against bad packages used by certain American manufacturers of goods like explosives and chemicals which must be restricted in transport. Some concerns have been delivering commodities of this character in containers which are not legal for shipboard handling, and perhaps not for rail or truck haulage.

# GERMANY ACQUIRES MANY SUDETEN CHEMICAL INDUSTRIES FROM CZECHOSLOVAKIA

**From Our German Correspondent**

WITH the annexation of the Sudetenlands of Czechoslovakia, Germany is acquiring some of Czechoslovakia's chief chemical plants and raw materials. The transfer of the industrial machinery will involve some difficulties because many of the originally German-owned factories have been taken over since the war by Czech financial interests, especially the semi-official Zivnostenska trade bank of Prague. At the end of the world war about 80 per cent of the old Austro-Hungarian Empire's industries were located in territories awarded to the Czechoslovak Republic, and about three-quarters of these were in German-populated areas of Bohemia and Moravia-Silesia. The Sudetenlands before the war were the most densely industrially populated area of all Europe. At the end of the war it is estimated that about 80 per cent of the industries were German-owned but in the meantime the balance has shifted so that the ratio of German to Czech capital in these enterprises is roughly 40 to 60.

The first chemical industries in Europe were established in the Sudetenlands in the 16th century to manufacture so-called Bohemian sulphuric acid from the pyrite deposits there. (*Chem. & Met.*, Sept. 1937). Some of the original companies are still in existence today, although they have been absorbed in the large combines. The present leading chemical company of central Europe, the Aussig Verein, was established around the middle of the last century, when the first soda factories using the Leblanc process were erected.

With its chief plant located at Aussig (Usti) at the northwestern tip of Bohemia very near the German border, this combine (Verein für Chemische und Metallurgische Produktion) was credited with more than 60 per cent of the total value of the Republic's chemical production last year. Although the combine controls some plants in other areas of Czechoslovakia, many of its factories are in predominantly German-speaking areas which are now being, or will be, turned over to the German Reich. The Aussig Verein's production program includes a well-balanced variety of products: sulphuric, hydrochloric, nitric, and hydrofluoric acids; caustic soda, caustic potash, sodium sulphate, potassium permanganate; mineral colors and coal-tar dyes; organic intermediates, as developers and bases, formic acid, oxalic acid, solvents, trichlorethylene, etc.; sachharine, nitrates, and phosphate fertilizers, active carbons, ferro-alloys, etc. Last year it opened some new units, widened its range of coal-tar dyes, and developed its lignite and power holdings in Slovakia.

The Aussiger Verein is also very close to the Witkowitz (Vitkovice) Iron Works of Moravia-Silesia. The Moravian hard coal basin adjoining the German Upper Silesian coal basin in the north, will probably also be included in the area going to Germany since a large German population lives there. If it is ceded to the Reich, this will mean the addition of a number of coking plants and other factories, partly built around the Witkowitz steel plant. Pilsen and the world-famed Skoda works further south, incidentally, are on the border line between German and Czech speaking areas—the ethnographic frontier according to the last government census runs a few miles west of Pilsen—and if the present population is taken as a basis of drawing the new frontier, this important industrial enterprise, whose production program extends far beyond armaments, will probably remain just within the Czech-retained areas.

### Synthetic Nitrogen Plants

Near Witkowitz in the north are also located the large synthetic nitrogen, ammonia and fertilizer plants of Mährisch-Ostrau (Moravska Ostrava), which will probably also come to Germany. Nearby is the frontier town of Oderberg (Bohumin), which is the home of several important chemical plants, notably the Oderberg Chemical Co., which is an affiliate of the Aussiger Verein and the leading producer in Czechoslovakia of saccharine, insecticides, pharmaceuticals and veterinarian preparations.

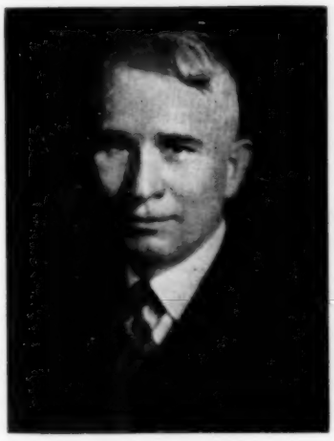
Further south and west in the Erzgebirge (Ore mountains) is St. Joachimstal with its radium uran-pitchblende deposits, which will also probably go to Germany. This whole frontier mountain region will bring valuable forest and mineral deposits to the Reich. Disputed will be valuable brown coal districts around Brüx and Dux where there is also a considerable Czech-speaking population. In the vicinity of Carlsbad, Germany will also be gaining valuable porcelain and Bohemian glass industries, the textile industries around Reichenberg and the glass bijouterie industry of Gablonz, which attained world fame before the war. The latter plants have become quite run down as a result of the severe economic conditions prevailing in these areas for many years. Reconditioning of these plants will keep the Germans busy for some time—assuming that the plants are all put into operation again. Many of them have become quite obsolete since the loss of markets and lack of capital have prevented necessary replacements being made, and many plants have been idle ever since the depression. Undoubtedly an aggressive program of public works will be launched in the Sudetic areas as in Austria to relieve the most acute effects of the widespread unemployment.

The chemical plants are on the whole in very good condition, but many of the other factories, which will be secondary consumers of chemicals, are in poor shape. Originally built last century because of the availability of the water power of mountain streams, they are usually strung out the length of relatively remote and narrow mountainous valleys. The disadvantage from the transportation standpoint is somewhat offset by the fact that the industries have at their disposal skilled labor trained for generations in making precision instruments, laces and textiles, grinding lenses, and cutting and blowing glass, etc.

For the chemical industry proper, the incorporation of the Sudetic areas in the German Reich will involve some important problems similar to those of Austria. Last year 47 per cent of the Czechoslovak Republic's chemical imports came from Germany as against 8 per cent from the United States. Czechoslovakia's chemical exports to Germany were only one-tenth the value of her chemical imports from the Reich. Thus, to a certain extent the Sudetic chemical industries complement those of Germany. On the other hand, some of the older plants will have to be modernized if they hope to be able to compete with the huge rationalized Reich concerns when they lose the protection of the former tariff barrier. The larger concerns are, of course, members of national and international cartels, and some agreement will undoubtedly be reached to aid Sudetic industries and protect them during the transition period while the economic readjustments connected with incorporation with the Reich are being made.

Since some of the larger chemical concerns of the Czechoslovak Republic have an active interest in Yugoslav, Roumanian, Hungarian, and Polish chemical companies, it is entirely conceivable that in the same way as with Austria, those companies coming to Germany will be utilized to further Germany's economic penetration of the Balkan and Danubian countries. In this they will be greatly aided by the additional advantage of cheap water transportation when the important Rhine-Main-Danube canal is completed in 1945. This will give the Ruhr and Frankfurt chemical industries an all-water route directly to the Black Sea touching all the southeastern European countries which could supply Germany with much needed raw materials.

# PERSONALITIES



Walter S. Landis

✦ WALTER S. LANDIS, vice-president of the American Cyanamid Co., has been elected to receive the 1939 Perkin Medal from the American section of the Society of Chemical Industry.

✦ GEORGE E. BARKER, Ph.D., Massachusetts Institute of Technology, 1934, has joined the staff of the Mellon Institute as incumbent of the Elgin National Watch Co. fellowship to study the chemical aspects of technical problems in the watch industry.

✦ J. E. BLACKBURN has been appointed circulation manager of the McGraw-Hill Publishing Co., Inc. Mr. Blackburn is a chemical engineering graduate of Rensselaer Polytechnic Institute and for the past nine years has been assistant circulation manager of the McGraw-Hill Co.

✦ ADOLPH BREGMAN, since 1919 managing editor of *Metal Industry*, has severed his connection with that journal and established an office in New York City as consultant in the metal products manufacturing and metal finishing industries.

✦ B. F. BUCHANAN, formerly instructor in the department of chemistry at Iowa State College, recently joined the technical service division of the American Maize Products Co. in New York.

✦ HENRY L. COLES has resigned his position as head of the department of chemical engineering at the University of Colorado to assume a like position at the University of Alabama. Dr. Coles is already active in his new work at Tuscaloosa.

✦ T. B. FORD, manager of the Dorr Co.'s Tokio office, is in the United States for a several months visit with his associates here.

✦ EVERETT G. HOLT has been appointed chief of the leather and rubber division of the United States Bureau of Foreign and Domestic Commerce. His position makes him a regular consultant of other government offices on all matters relating to leather and rubber industries.

✦ P. K. LAWRENCE, formerly with the chemical division of the U. S. Tariff Commission, is now associated with E. I. du Pont de Nemours & Co. at Wilmington.

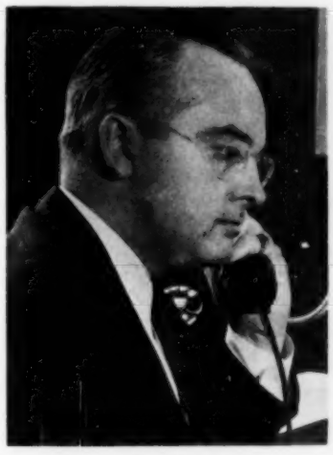
✦ ELLSWORTH MCSWEENEY has been appointed research associate at Battelle Memorial Institute to study organic tin compounds.

✦ WALTER R. MEYER, former chief metallurgist and electrochemist of the General Electric Co. at Bridgeport, Conn., has been appointed managing editor of *Metal Industry*.

✦ C. S. QUILLEN has been placed in charge of field engineering for the Mixing Equipment Co. in New York City and central southern territory.

✦ GEORGE R. ROESCHLAUB, formerly technical adviser of the Denver Fire Clay Co., has been appointed Chicago representative by the Coleman Electric Co., and will be in charge of their testing laboratories.

✦ ARTHUR E. PINKNEY, formerly with the Pan-American Color & Chemical Co., is now associated in a technical capacity with the Commonwealth Color & Chemical Co., Brooklyn, N. Y.



O. M. Gibson

✦ O. M. GIBSON, former metallurgist, Dodge Bros. Corp., has been appointed research director of G. F. Rogers & Co., Chicago manufacturers of metal treating and finishing materials. All production control and research laboratories of the company's middle western and eastern seaboard plants will be under his supervision.

## OBITUARY

✦ JOHN W. DAVIS, 51, inventor of the process for separating helium from natural gas, died Oct. 4 at Petersburg, Va. He was a consulting engineer with the Atmospheric Nitrogen Corp.

✦ GEORGE ROSS FORD, SR., 56, retired glass manufacturer and grandson of Capt. John B. Ford, founder of the plate glass industry in America, died Sept. 2 at his country home near Toledo, Ohio.

✦ JOHN R. GRIFFITH, 56, of the Norton Co.'s electric furnace plant at Chippewa, Ont., died Sept. 6. Mr. Griffith had been associated with the Norton Co. since 1911.

✦ A. H. MCDOWELL, Detroit representative of W. H. & L. D. Betz, chemical engineering consultants, died Aug. 8. Mr. McDowell has been identified in the field of chemistry for many years as a specialist in water treatment.

✦ FRANK B. MCMILLIN, 69, president of the Hydraulic Press Mfg. Co., died Sept. 8 at his home in Mount Gilead, Ohio.

## CALENDAR

**OCT.** 21-22, ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT, annual meeting, Engineering Societies Building, New York, N. Y.

**NOV.** 9-11, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting, Benjamin Franklin Hotel, Philadelphia, Pa.

**NOV.** 14-18, AMERICAN PETROLEUM INSTITUTE, Hotel Stevens, Chicago, Ill.

**DEC.** 5-10, THIRTEENTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, Grand Central Palace, New York City.

**APRIL** 16-21, 1939, AMERICAN CERAMIC SOCIETY, Hotel Stevens, Chicago, Ill.

**MAY,** 1939, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Akron, O.

# Chemical ECONOMICS and MARKETS

## CONSUMPTION OF CHEMICALS IN SEPTEMBER REACHED HIGHEST POINT FOR THE YEAR

CONSUMING industries continued to improve their position in the last month with a consequent wider demand for chemicals and other raw materials. The latter part of September saw a lessening in operations in some activities but this was more than offset by increased operations in other directions. Notable gains were recorded in production of plate and window glass in September. Silk and woolen mills held production on a rising scale but some slowing down was noted at cotton mills in the latter part of the month. Rayon deliveries also were under the record level reached in the preceding month. The paint, steel and iron, leather, and plastics industries reported progress and the output of coal products also was raised over that reported for August.

The *Chem & Met.* index for consumption of chemicals for September, based on incomplete data, will approximate 107 as compared with 104.99 for August and a revised index of 92.66 for July. The revision in the number for July is largely due to the fact that the wrong factor was used in computing the position of the fertilizer industry for that month.

***Chem. & Met.* Index for Consumption of Chemicals**

| | July (Revised) | August |
|---|---|---|
| Fertilizer | 17.55 | 22.35 |
| Pulp and paper | 13.14 | 13.90 |
| Glass | 8.48 | 9.30 |
| Petroleum refining | 13.03 | 13.30 |
| Paint and varnish | 9.07 | 10.71 |
| Iron and steel | 5.40 | 5.96 |
| Rayon | 5.15 | 5.22 |
| Textiles | 6.20 | 7.16 |
| Coal products | 4.55 | 5.21 |
| Leather, glue, and gelatine | 3.65 | 4.31 |
| Explosives | 3.38 | 4.04 |
| Rubber | 1.76 | 2.09 |
| Plastics | 1.30 | 1.44 |
| | 92.66 | 104.99 |

The upward swing to consumption of chemicals was the result of enlarged operations in the pulp and paper, glass, paint and varnish, iron and steel, rayon, coal products, leather, and plastics industries. In August there was a notable rise in superphosphate production with the glass trade also contributing materially to the rise in the index number. In fact all of the industries which are included in the index made a better showing in August than they had in July.

Reports regarding October activities indicate that industrial production is still on an upward trend. The enlarging of schedules for automotive production is having a widespread effect with a wider demand for a varied line of raw materials.

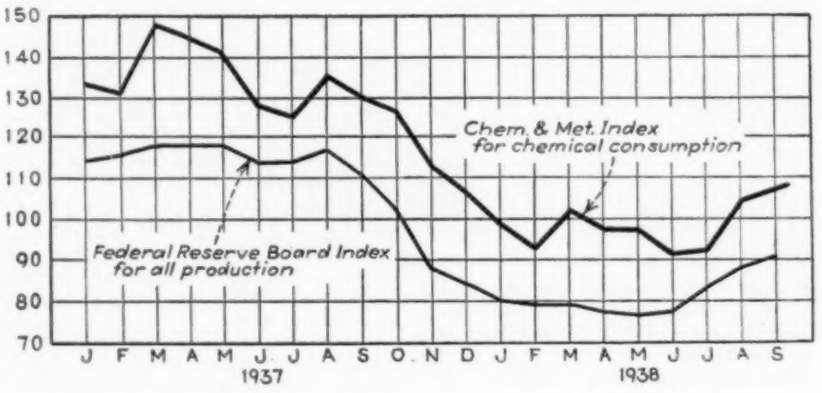
The Federal Reserve Board in reporting on industrial production stated that although consumers' goods lines—textiles, leather, meat packing and tobacco—continue to lead the industrial advance, a more recent upturn in steel, automobile and glass production has given the recovery movement support from the heavy goods industries.

The board's production index for September will be above 90, based on 1923-25 as 100, for the first time since last October. In August the index, adjusted for seasonal variations, climbed to 88, the highest point it had reached since November, 1937. The index of 88 for August compares with 83 in July, and with 76 in May which was the low point of the year.

A drop of 3.6 per cent in freight carloadings in the fourth quarter this year from the like 1937 period is expected, according to estimates compiled by the 13 Shippers' Advisory Boards.

Manufacturers' sales during August, 1938, declined 18 per cent from last August according to reports from 1,270 manufacturers cooperating in the monthly joint study of the National Association of Credit Men and the Bureau of Foreign and Domestic Commerce.

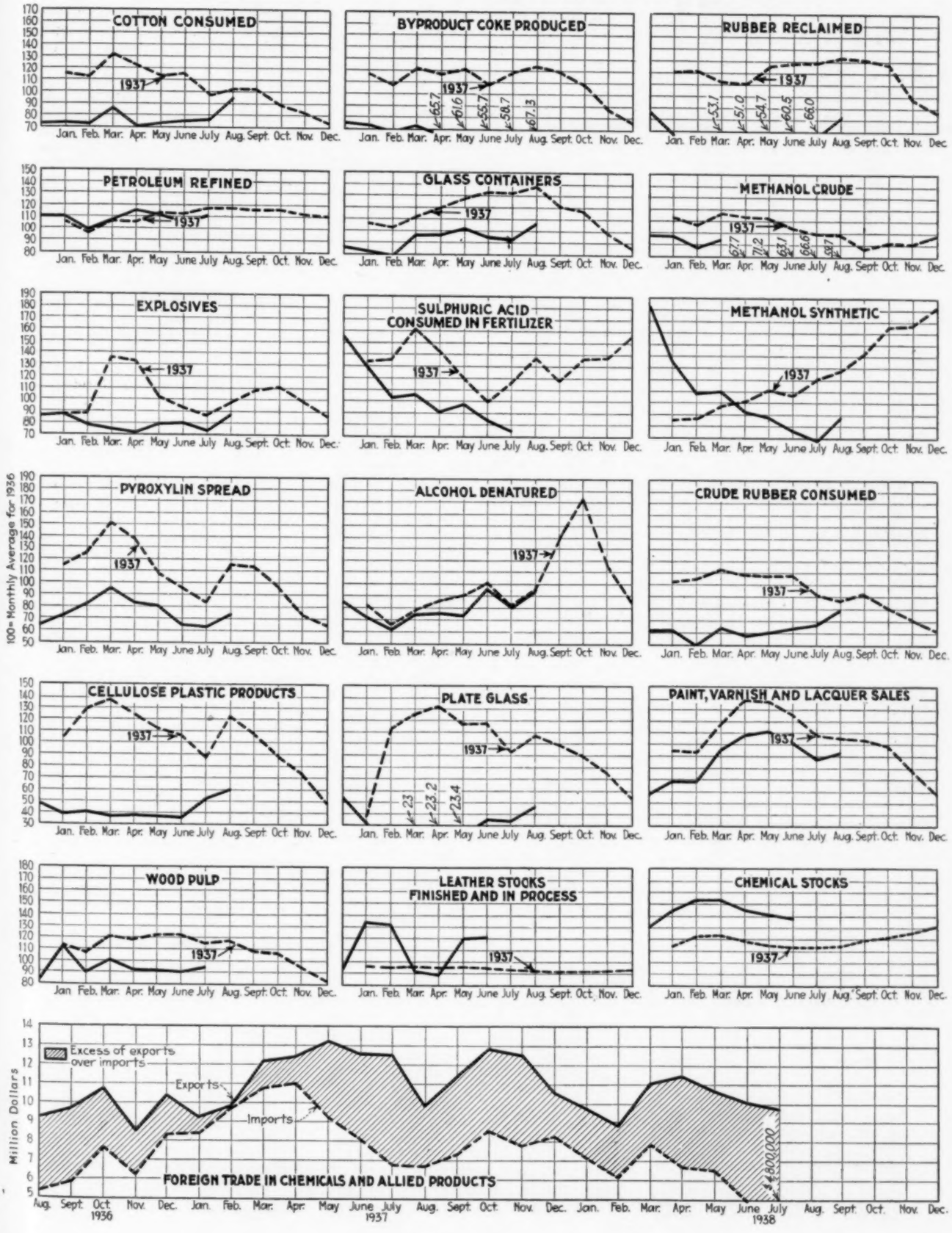
Without adjustment for seasonal factors there was an increase of 17 per cent in sales from July to August of this year. This comparison is considerably more favorable than the 9 per cent increase between these two months last year and the one per cent increase recorded in 1936.




**Production and Consumption Data for Chemical-Consuming Industries**

| | Aug., 1938 | Aug., 1937 | Jan.-Aug., 1938 | Jan.-Aug., 1937 | Per cent of decline for 1938 |
|---|---|---|---|---|---|
| **Production** | | | | | |
| Alcohol, ethyl, 1000 pr. gal | 17,284 | 17,067 | 127,875 | 143,892 | 11.1 |
| Alcohol denatured, 1000 wi. gal | 7,846 | 7,932 | 51,990 | 56,376 | 7.8 |
| Automobiles, no | 90,484 | 394,330 | 1,435,795 | 3,622,197 | 60.4 |
| Benzol, 1000 gal | 5,585 | 11,144 | 42,785 | 82,827 | 48.3 |
| Byproduct coke, 1000 tons | 2,494 | 4,571 | 19,388 | 34,689 | 44.1 |
| Glass containers, 1000 gr | 4,031 | 5,259 | 24,855 | 31,752 | 21.7 |
| Plate glass, 1000 sq. ft | 7,676 | 17,898 | 38,409 | 139,820 | 72.5 |
| Methanol, crude, gal | 277,182 | 462,584 | 2,825,108 | 4,040,837 | 30.1 |
| Methanol, synthetic, gal | 1,897,847 | 2,735,963 | 16,344,754 | 17,813,509 | 8.2 |
| Nitrocellulose plastics, 1000 lb | 977 | 1,642 | 5,656 | 13,264 | 57.4 |
| Cellulose acetate plastics, 1000 lb | 546 | 1,416 | 2,850 | 9,685 | 70.6 |
| Pyroxylin spread, 1000 lb | 4,815 | 5,982 | 32,863 | 48,233 | 31.9 |
| Rosin, wood, bbl | 54,479 | 68,332 | 380,442 | 501,097 | 24.1 |
| Turpentine, wood, bbl | 8,389 | 10,410 | 58,892 | 77,650 | 24.2 |
| Rubber reclaimed, tons | 10,732 | 16,543 | 60,406 | 123,292 | 51.0 |
| **Consumption** | | | | | |
| Cotton, bales | 561,406 | 604,380 | 3,666,944 | 5,377,194 | 31.8 |
| Silk, bales | 38,504 | 33,557 | 260,516 | 299,194 | 12.9 |
| Wool, 1000 lb | 29,161 | 28,712 | 154,808 | 270,743 | 42.8 |
| Explosives, 1000 lb | 27,663 | 30,811 | 199,895 | 260,276 | 23.2 |
| Rubber, tons | 38,170 | 41,456 | 241,723 | 395,598 | 38.9 |

# Production and Consumption Trends



## LARGER DEMAND FOR CHEMICALS INDICATED FOR LATTER PART OF YEAR

STEADY improvement has been noted in demand for chemicals in recent weeks and prospects are favorable for larger gains in the current month. The larger part of current business has been represented by a freer movement of chemicals against existing contracts rather than by any notable activity in spot buying. Basically, the better position of the market rests upon the fact that practically all large consuming trades have increased manufacturing operations and reversed the trend which was experienced in the period from March to June. The current movement of soda ash into glass manufacture is appreciably higher than at any preceding time this year. Soap makers have taken normal amounts of alkalis over the year to date but caustic soda was adversely affected by the slowing up of rayon production and present activities at rayon plants have brought about a better condition in the caustic market where stocks had threatened to present a problem.

Price changes for chemicals in the last month were not frequent and, with the exception of metal salts, which follow the swings in metal prices, appear to be well established around present levels. Higher production costs combined with competitive selling have kept values down to a low profit margin and should buying interest continue to expand, a stronger price tone would be logical with a lessening in sales pressure.

Oils and fats, likewise, showed less than usual price fluctuations in the last few weeks. Crude cottonseed held a firmer position at the close of the period with holders of seed revising their views upwards. Linseed oil sold at an advance following advances in flaxseed and the level of prices for the near future probably will vary according to demand for oil. Oils of foreign origin changed but little although offerings of China wood oil were available under the figures quoted in the preceding month.

Naval stores which have been depressed for a long period showed signs of recovery late in the period especially in the case of rosin. The situation was helped by the announcement that an additional loan of $2,500,000 had been granted to the American Turpentine Farmers Cooperative to enable it to advance funds to producer members against their stocks of rosin. This loan granted by the Commodity Credit Corp. supplements a previous loan of $10,000,000. It was reported that through Sept. 16, naval stores pledged to the corporation, as collateral against loans, amounted to 8,698,954 gal. of turpentine and 672,932 round bbl. and-or metal drums of gum rosin.

Quicksilver has attracted attention recently because of higher prices which have gone into effect and products into which this material enters also were firmer including vermilion. Production of quicksilver in Italy for the first half of this year was reported at 1,230 tons as compared with 1,213 tons for the first half of last year. Exports for the first six months of this year, however, were 568 tons below the amount shipped out in the corresponding period of 1937 and this is said to be partly due to the increase in production of mercurials at Italian plants.

Consumption of sulphuric acid in the manufacture of fertilizer moved up sharply in August, reaching a total of 128,312 tons or a gain of 36,123 tons over the total reported for July. For the eight months ended July, the comparison is less favorable, the totals being 954,413 tons for 1938 and 1,276,237 tons for 1937. However, the 1938 figure is an increase of 130,703 tons over that for the comparable period of 1936.

In order to conserve its supply of soda ash, Japan has instructed customs officials to readmit to Japan, empty bottles free of duty if the bottles had been made in that country. It is stated that Japan shipped to China in the first five months of this year approximately 20,000,000 bottles representing an investment of about 700,000 yen in soda ash. Japan imported soda ash to the value of 1,018,806 yen in the first half of this year and the new ruling is planned to reduce imports of ash.

Following receipt from the Treasury Department of a statement that investigations by the Public Health Service indicate that the health of consumers will not be endangered by the change, the Secretary of Agriculture has issued notice that the quantity of lead residue permitted on fruits shipped interstate will be raised to 0.025 grain per lb. of fruit. The lead tolerance previously enforced under the Food and Drugs Act was 0.018 grain per lb. The tolerances for arsenic and fluorine residue remain unchanged at 0.01 grain per lb.

New formula for rubbing alcohol which gives the product the same qualities but reduces the unpleasant odor has been submitted to the Technical Committee of the industry for investigation and comment. The formula has been prepared in reply to repeated applications reaching the industrial alcohol denatures by the experts of the Laboratory division of the Treasury Department after extensive experiments.

The new formula is reported to be as effective as a denaturent agent as the agent currently used (Formula 23-G) as a base for the manufacture of rubbing alcohol, while possessing odor characteristics distinctly more pleasant.

Manufacture of artificial rubber, known under Polish patents as "Ker," is about to be commenced in that country, according to a statement by the Polish Chemical Association. A large building for housing the project has already been constructed at Debica, which is located in the newly-designated Central Industrial District of Poland. Sources in Poland claim that if full plant capacity is achieved the production cost of synthetic rubber will amount to about 65 to 70 per cent of the cost of importing natural rubber, including customs duties.

Shift of the flow of tung oil due to the Japanese-China warfare, is reported from the Orient. Instead of following the former route from Hankow by junk to Shanghai for reshipment in ocean going bottoms, the drying oil is now being cleared from Hankow via the Hankow-Canton railroad and re-shipped from the British port of Hong Kong in quantities sufficient to meet world demand, according to information reaching the Department of Commerce. Reexports of tung oil from Hong Kong in July amounted to 12,367,600 lb., of which 9,646,800 lb. came to the United States, the remainder going to Europe. This is well above the normal figure for this season. In August Hankow reported clearing about 8,800,000 lb. of tung oil, and stocks on hand of approximately 22,000,000 lb.

### CHEM. & MET.
**Weighted Index of**
### CHEMICAL PRICES

Base = 100 for 1935

| | |
|---|---|
| **This month** | **99.47** |
| Last month | 99.33 |
| October, 1937 | 102.25 |
| October, 1936 | 98.31 |

Higher prices were effective for the lead, tin, and copper salts and sales schedules for denatured alcohol also were marked up. One producer reduced the price of sulphur by $2 a ton to apply on future contracts.

### CHEM. & MET.
**Weighted Index of Prices for**
### OILS AND FATS

Base = 100 for 1935

| | |
|---|---|
| **This month** | **77.01** |
| Last month | 77.07 |
| October, 1937 | 94.19 |
| October, 1936 | 102.56 |

Price changes were less numerous in the market for oils and fats last month. Linseed oil was marked up but China wood oil was lower and olive oil foots also sold at lower levels. Animal oils and fats held a fairly steady position.

# Current PRICES

## INDUSTRIAL CHEMICALS

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Acetone, drums, lb. | $0.05½–$0.06½ | $0.05½–$0.06½ | $0.06 –$0.07 |
| Acid, acetic, 28%, bbl., cwt. | 2.23 – 2.48 | 2.23 – 2.48 | 2.38 – 2.63 |
| Glacial 99%, drums | 8.43 – 8.68 | 8.43 – 8.68 | 8.43 – 8.68 |
| U. S. P. reagent | 10.25 –10.50 | 10.25 –10.50 | 10.25 –10.50 |
| Boric, bbl., ton | 106.00–111.00 | 106.00–111.00 | 105.00–115.00 |
| Citric, kegs, lb. | .23½– .25 | .23½– .25 | 24 – 27 |
| Formic, bbl., ton | 10½– .11 | 10½– .11 | 11 – 11½ |
| Gallic, tech., bbl., lb. | .70 – .75 | 70 – 75 | 75 – 78 |
| Hydrofluoric 30% carb., lb. | .07 – .07½ | .07 – .07½ | 07 – 07½ |
| Lactic, 44%, tech., light, bbl., lb. | .06½– .06½ | .06½– .06½ | 6½ – 6½ |
| Muriatic, 18°, tanks, cwt. | 1.05 –..... | 1.05 –..... | 1.05 –..... |
| Nitric, 36°, carboys, lb. | .05 – .05½ | .05 – .05½ | 05 – .05½ |
| Oleum, tanks, wks., ton | 18.50 –20.00 | 18.50 –..... | 18.50 –20.00 |
| Oxalic, crystals, bbl., lb. | 10½– .12 | 10½– .12 | 10½– 12 |
| Phosphoric, tech., c'bys., lb. | 09 – .10 | 09 – .10 | 09 – 10 |
| Sulphuric, 60°, tanks, ton | 13.00 –..... | 13.00 –..... | 13.00 –..... |
| Sulphuric, 66°, tanks, ton | 16.50 –..... | 16.50 –..... | 16.50 –..... |
| Tannic, tech., bbl., lb. | 40 – 45 | 40 – 45 | 40 – .45 |
| Tartaric, powd., bbl., lb. | .27½– ..... | .27½–..... | 24½–..... |
| Tungstic, bbl., lb. | 2.75 –..... | 2.75 –..... | 2.75 –..... |
| Alcohol, Amyl | ..... | ..... | ..... |
| From Pentane, tanks, lb. | .106–..... | .106..... | 12½–..... |
| Alcohol, Butyl, tanks, lb. | 08½–..... | 08½–..... | 08½–..... |
| Alcohol, Ethyl, 190p'f., bbl., gal. | 4.61½–..... | 4.58½–..... | 4.14 –..... |
| Denatured, 190 proof | ..... | ..... | ..... |
| No. 1 special, dr., gal wks. | .30 –..... | .29 –..... | .34 –..... |
| Alum, ammonia, lump, bbl., lb. | .03½– .04 | .03½– .04 | .03 – .04 |
| Potash, lump, bbl., lb. | .03½– .04 | .03½– .04 | .03½– .04 |
| Aluminum sulphate, com bags cwt. | 1.15 – 1.40 | 1.15 – 1.40 | 1.35 – 1.50 |
| Iron free, bg., cwt. | 1.30 – 1.55 | 1.30 – 1.55 | 2.00 – 2.25 |
| Aqua ammonia, 26°, drums, lb. | .02 – .03 | .02 – .03 | .02½– .03 |
| tanks, lb. | .02 – .02½ | .02 – .02½ | .02½– .02½ |
| Ammonia, anhydrous, cyl., lb. | .15½–..... | .15½–..... | 15½– .16 |
| tanks, lb. | .04½–..... | .04½–..... | 04½–..... |
| Ammonium carbonate, powd tech., casks, lb. | 08 – .12 | .08 – .12 | .08 – .12 |
| Sulphate, wks., cwt. | 1.3625– | 1.35 –..... | 1.425–..... |
| Amylacetate tech., tanks, lb. | .09½ –..... | 09½– .12 | .11 – .11½ |
| Antimony Oxide, bbl., lb. | .11½– .12 | 11½– .12 | 15½– .16 |
| Arsenic, white, powd., bbl., lb. | .03 – .03½ | .03 – .03½ | 03 – .03½ |
| Red, powd., kegs, lb. | .15½– .16 | .15½– .16 | 15½– .16 |
| Barium carbonate, bbl., ton | 52.50 –57.50 | 52.50 –57.50 | 52.50 –57.50 |
| Chloride, bbl., ton | 79.00 –81.00 | 79.00 –81.00 | 79.00 –81.00 |
| Nitrate, cask, lb. | .07 – .08 | .07 – .08 | .07 – 08 |
| Blanc fixe, dry, bbl., lb. | .03½– .04 | .03½– .04 | .03½– 04 |
| Bleaching powder, f. o b., wks., drums, cwt. | 2.00 – 2.10 | 2.00 – 2.10 | 2.00 – 2.10 |
| Borax, gran., bags, ton | 48.00 –51.00 | 48.00 –51.00 | 46.00 –51.00 |
| Bromine, cs., lb. | .30 – .32 | .30 – .32 | 36 – 38 |
| Calcium acetate, bags | 1.65 –..... | 1.65 –..... | 1.95 –..... |
| Arsenate, dr., lb | .06½– .07 | .06½– 07 | .06½– .07 |
| Carbide drums, lb. | .05 – .06 | .05 – 06 | .05 – .06 |
| Chloride, fused, dr., del., ton | 21.50 –24.50 | 21.50 –24.50 | 20.00 –33.00 |
| flake, dr., del., ton | 23.00 –25.00 | 23.00 –25.00 | 22.00 –35.00 |
| Phosphate, bbl., lb. | .07½– .08 | .07½– .08 | .07½– .08 |
| Carbon bisulphide, drums, lb. | .05 – .06 | .05 – 06 | .05 – .06 |
| Tetrachloride drums, lb. | .04½– .05½ | .05½– .06 | .05½– .06 |
| Chlorine, liquid, tanks, wks., lb. | 2.15 –..... | 2.15 –..... | 2.15 –..... |
| Cylinders | .05½– .06 | .05½– .06 | 05½– .06 |
| Cobalt oxide, cans, lb. | 1.67 – 1.70 | 1.67 – 1.70 | 1.67 – 1.70 |
| Copperas, bgs., f.o.b., wks., ton. | 15.00 –16.00 | 15.00 –16.00 | 15.00 –16.00 |
| Copper carbonate, bbl., lb. | .10 – 16½ | 10 – 16½ | 10½– 19½ |
| Sulphate, bbl., cwt. | 4.40 – 4.65 | 4.25 – 4.40 | 5.00 – 5.25 |
| Cream of tartar, bbl., lb. | .22½– .23 | .22½– .23 | .19½– .20 |
| Diethylene glycol, dr., lb. | .22 – .23 | 22 – .23 | 22 – .23 |
| Epsom salt, dom., tech., bbl., cwt. | 1.80 – 2.00 | 1.80 – 2.00 | 1.80 – 2.00 |
| Ethyl acetate, drums, lb. | .06½– | 06½– | .07½–..... |
| Formaldehyde, 40%, bbl., lb. | .05½– .06½ | .05½– .06½ | .05½– .6½ |
| Furfural, dr., lb | .10 – .17½ | 10 – .17½ | 10 – .17½ |
| Fusel oil, ref. drums, lb. | .12½– .14 | .12½ – .14 | 16 – .18 |
| Glaubers salt, bags, cwt. | 95 – 1.00 | 95 – 1.00 | 95 – 1.00 |
| Glycerine, c.p., drums, extra, lb | 16½–..... | 16½–..... | 23½–..... |
| Lead: | | | |
| White, basic carbonate, dry casks, lb. | .06½–..... | .06½–..... | .08 –..... |
| White, basic sulphate, sck., lb | .06 –..... | .06 –..... | .07½–..... |
| Red, dry, sck., lb. | .08 –..... | .074 –..... | .08½–..... |
| Lead acetate, white crys., bbl., lb | .10 – .11 | 10 – 11 | .12 – .13 |
| Lead arsenate, powd., bbl., lb. | .11 – .11½ | .12½– .13 | .11½– .12 |
| Lime, chem., bulk, ton | 8.50 –..... | 8.50 –..... | 8.50 –..... |
| Litharge, pwd., csk., lb. | .066–..... | .064–..... | .07½–..... |
| Lithophone, bags, lb. | .04½– .04½ | .04½– .04½ | .04½– .05 |
| Magnesium carb., tech., bags, lb. | .06 – .06½ | 06 – .06½ | .06 – 06½ |

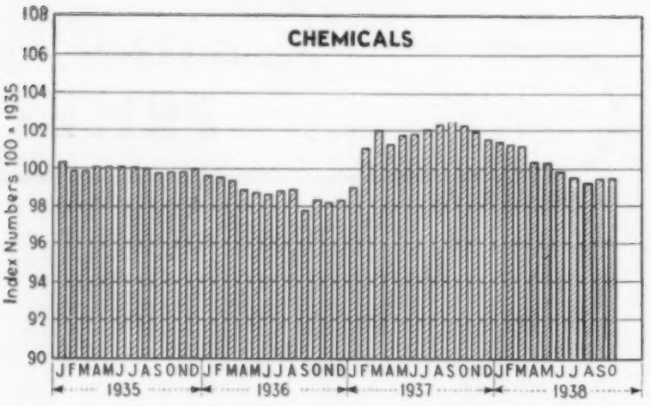
| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Methanol, 95%, tanks, gal. | 31 –..... | .31 –..... | .31 –..... |
| 97%, tanks, gal. | 32 –..... | .32 –..... | 32 –..... |
| Synthetic, tanks, gal. | 33 –..... | .33 –..... | 33 –..... |
| Nickel salt, double, bbl., lb. | 13 – 13½ | 13 – 13½ | 13 – 13½ |
| Orange mineral, csk., lb. | .10½–..... | .10½–..... | .11½–..... |
| Phosphorus, red, cases, lb. | .40 – 42 | .40 – 42 | .40 – 42 |
| Yellow, cases, lb. | 24 – 30 | .24 – 30 | .24 – 30 |
| Potassium bichromate, casks, lb | .08½– 09 | .08½– 09 | 08½– 09 |
| Carbonate, 80–85%, calc. csk., lb | .05½– .06 | 05½– .06 | .06½ .07 |
| Chlorate, powd., lb. | 09½–..... | .09½–..... | .09½– ..... |
| Hydroxide (c'stic potash) dr., lb | 07 – 07½ | 07 – 07½ | 07 – .07½ |
| Muriate, 80% bgs., unit | .53½–..... | .53½–..... | .53½–..... |
| Nitrate, bbl. lb. | .05½– 06 | 05½– .06 | .05½– .06 |
| Permanganate, drums, lb. | .18½– .19 | 18½– .19 | 18½– .19 |
| Prussiate, yellow, casks, lb. | .15 – .16 | 15 – .16 | .15 – .16 |
| Sal ammoniac, white, casks, lb. | .05 – 05½ | 05 – .05½ | .05 – .05½ |
| Salsoda, bbl., cwt. | 1.00 – 1.05 | 1.00 – 1.05 | 1.00 – 1.05 |
| Salt cake, bulk, ton | 13.00 –15.00 | 13.00 –15.00 | 13.00 –15.00 |
| Soda ash, light, 58%, bags, contract, cwt. | 1.23 –..... | 1.23 –..... | 1.23 –..... |
| Dense, bags, cwt. | 1.25 –..... | 1.25 –..... | 1.25 –..... |
| Soda, caustic, 76%, solid, drums, contract, cwt. | 2.60 – 3.00 | 2.60 – 3.00 | 2.60 – 3.00 |
| Acetate, works, bbl., lb. | 04 – 05 | .04 – 05 | 04½– .05 |
| Bicarbonate, bbl., cwt. | 1.75 – 2.00 | 1.75 – 2.00 | 1.75 – 2.00 |
| Bichromate, casks, lb. | 06½– 07 | 06½– 07 | 06½– 07 |
| Bisulphate, bulk, ton | 15.00 –16.00 | 15.00 –16.00 | 15.00 –16.00 |
| Bisulphite, bbl., lb. | 03½– 04 | 03½– 04 | 03½– 04 |
| Chlorate, kegs, lb. | .06½– 06½ | 06½– 06½ | 06½– 06½ |
| Chloride, tech., ton | 12.00 –14.75 | 12.00 –14.75 | 12.00 –14.75 |
| Cyanide, cases, dom., lb. | .14 – .15 | 14 – .15 | .16½– .17 |
| Fluoride, bbl., lb. | 07½– 08 | 07½– 08 | 07½– .08 |
| Hyposulphite, bbl., cwt. | 2.40 – 2.50 | 2.40 – 2.50 | 2.40 – 2.50 |
| Metasilicate, bbl., cwt. | 2.20 – 3.20 | 2.20 – 3.20 | 2.15 – 3.15 |
| Nitrate, bags, cwt. | 1.45 – | 1.45 – | 1.45 –..... |
| Nitrite, casks, lb. | .06½– .07 | .06½– .07 | 07 – 08 |
| Phosphate, dibasic, bags, lb. | 1.85 –..... | 1.85 – | 1.70 – 024 |
| Prussiate, yel drums, lb. | .09½– 10 | 09½– 10 | 10 – .11 |
| Silicate (40° dr.) wks., cwt. | .80 – 85 | 80 – 85 | 80 – 85 |
| Sulphide, fused, 60–62%, dr., lb. | 02½– 03½ | .02½– 03 | 02½– .03 |
| Sulphite, crys., bbl., lb. | 02½– 02½ | .02½– 02½ | 02½– .02½ |
| Sulphur, crude at mine, bulk, ton. | 16.00 –..... | 18.00 –..... | 18.00–..... |
| Chloride, dr., lb. | 03 – .04 | 03 – .04 | 03½– .04 |
| Dioxide, cyl., lb. | .07 – .08 | .07 – .08 | .07 – .07½ |
| Flour, bag, cwt. | 1.60 – 3.00 | 1.60 – 3.00 | 1.60 – 3.00 |
| Tin Oxide, bbl., lb. | 48 –..... | .48 –..... | .60 –..... |
| Crystals, bbl., lb. | .35 –..... | .34½–..... | .40 –..... |
| Zinc, chloride, gran., bbl., lb. | .05 – 06 | .05 – .06 | .05 – .06 |
| Carbonate, bbl., lb. | 14 – 15 | 14 – .15 | 09 – .11 |
| Cyanide, dr., lb. | .33 – .35 | 33 – .35 | 36 – .38 |
| Dust, bbl., lb. | .07 –..... | .06½–..... | .084–..... |
| Zinc oxide, lead free, bag., lb. | 06½–..... | 06½–..... | .06½–..... |
| 5% lead sulphate, bags, lb. | 06½–..... | 06½–..... | .06½–..... |
| Sulphate, bbl., cwt. | 3.15 – 3.60 | 3.15 – 3.60 | 3.15 – 3.60 |

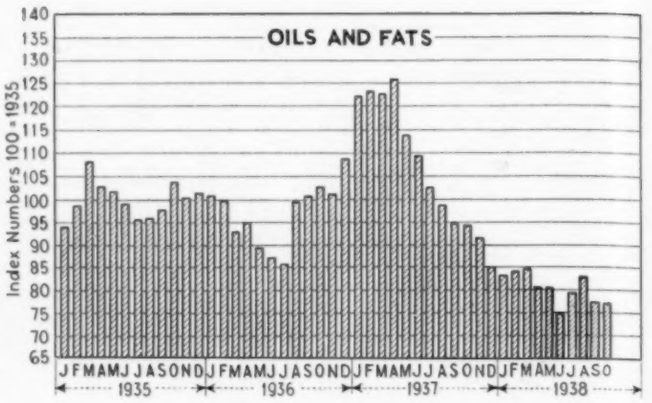
## OILS AND FATS

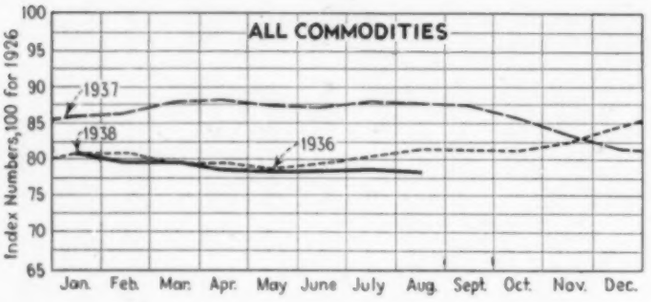
| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Castor oil, No. 3, bbl., lb. | $0.09½–$0.10 | $0.09½–$0.10 | $0.10½–$0.11 |
| Chinawood oil, bbl., lb. | .12½–..... | .13 –..... | .25 –..... |
| Coconut oil, Ceylon, tanks, N. Y. lb. | .03½–..... | .03½–..... | 05 –..... |
| Corn oil crude, tanks (f.o.b. mill), lb. | .07 –..... | .07½–..... | .06½–..... |
| Cottonseed oil, crude (f.o.b. mill) tanks, lb. | .06½–..... | .06½–..... | .05½–..... |
| Linseed oil, raw car lots, bbl., lb. | .086–..... | .081–..... | .11 –..... |
| Palm, casks, lb. | .036–..... | .04½–..... | .06½–..... |
| Peanut oil, crude, tanks (mill), lb | .07 –..... | .07½–..... | .06½–..... |
| Rapeseed oil, refined, bbl., gal. | .75 –..... | .75 –..... | .96 –..... |
| Soya bean, tank, lb. | .05½–..... | .05½–..... | .06½–..... |
| Sulphur (olive foots), bbl., lb. | .06½–..... | .07½–..... | .10 –..... |
| Cod, Newfoundland, bbl., gal. | .38 –..... | .38 –..... | .52 –..... |
| Menhaden, light pressed, bbl., lb | .061–..... | .067–..... | .074–..... |
| Crude, tanks (f.o.b. factory), gal | .30 –..... | .30 –..... | .35 –..... |
| Grease, yellow, loose, lb. | .04½–..... | .04½–..... | .05½–..... |
| Oleo stearine, lb. | .07 –..... | .07½–..... | .09 –..... |
| Oleo oil, No. 1 | .09½–..... | .09½–..... | .11 –..... |
| Red oil, distilled, d.p. bbl., lb. | .08½–..... | .08½–..... | .10½–..... |
| Tallow extra, loose, lb. | .05½–..... | .05½–..... | .07½–..... |

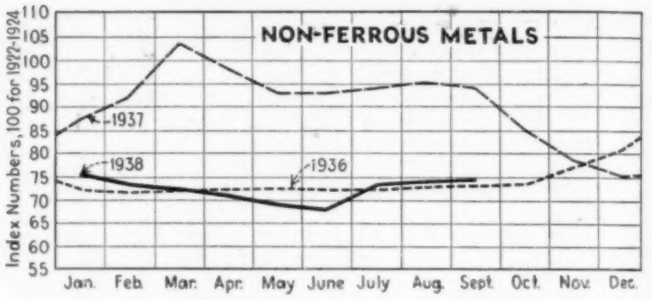
**The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Oct. 11**

# Chem. & Met.'s Weighted Price Indexes




## COAL-TAR PRODUCTS

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Alpha-napthol, crude bbl., lb. | $0.52 -$0.55 | $0.52 -$0.55 | $0.52 -$0.55 |
| Alpha-naphthylamine, bbl., lb. | .32 - .34 | .32 - .34 | .32 - .34 |
| Aniline oil, drums, extra, lb. | .15 - .16 | .15 - .16 | .15 - .16 |
| Aniline salts, bbl., lb. | .22 - .24 | .22 - .24 | .22 - .24 |
| Benzaldehyde, U.S.P., dr., lb. | .85 - .95 | .85 - .95 | .85 - .95 |
| Benzidine base, bbl., lb. | .70 - .75 | .70 - .75 | .70 - .75 |
| Benzoic acid, U.S.P., kgs., lb. | .54 - .56 | .54 - .56 | .52 - .54 |
| Benzyl chloride, tech., dr., lb. | .25 - .27 | .25 - .27 | .25 - .27 |
| Benzol, 90%, tanks, works, gal. | .16 - .18 | .16 - .18 | .16 - .18 |
| Beta-napthol, tech., drums, lb. | .23 - .24 | .23 - .24 | .23 - .24 |
| Cresol, U.S.P., dr., lb. | .10½- .11 | .10½- 11 | .12 - .13 |
| Cresylic acid, dr., wks., gal. | .78 - .80 | .78 - 80 | .92 - 1.00 |
| Diethylaniline, dr., lb. | .40 - .45 | .40 - .45 | .50 - .55 |
| Dinitrophenol, bbl., lb. | .23 - .25 | .23 - .25 | .23 - .25 |
| Dinitrotoluen, bbl., lb. | .15 - .16 | .15 - .16 | .15 - .16 |
| Dip oil, 15%, dr., gal. | .23 - .25 | .23 - .25 | .23 - .25 |
| Diphenylamine, bbl., lb. | .32 - .36 | .32 - .36 | .32 - .36 |
| H-acid, bbl., lb. | .50 - .55 | .50 - .55 | .50 - .55 |
| Naphthalene, flake, bbl., lb. | .05½- .06 | .05½- .06 | .07½- .07½ |
| Nitrobenzene, dr., lb. | .08 - .09 | .08 - .09 | .08 - .09 |
| Para-nitraniline, bbl., lb. | .50 - .52 | .50 .52 | .45 - .47 |
| Phenol, U.S.P., drums, lb. | .14½- ..... | .14½- ..... | .14½- ..... |
| Picric acid, bbl., lb. | .35 - .40 | .35 - .40 | .35 - .40 |
| Pyridine, dr., gal. | 1.55 - 1.60 | 1.55 - 1.60 | 1.55 - 1.60 |
| Resorcinal, tech., kegs, lb. | .75 - .80 | .75 - .80 | .75 - .80 |
| Salicylic acid, tech., bbl., lb. | .33 - .40 | .33 - .40 | .34 - .40 |
| Solvent napths, w.w., tanks, gal. | .26 - ..... | .26 - ..... | .30 - ..... |
| Tolidine, bbl., lb. | .88 - .90 | .88 - .90 | .88 - .90 |
| Toluene, tanks, works, gal. | .27 - ..... | .27 - ..... | .35 - ..... |
| Xylene, com, tanks, gal. | .26 - ..... | .26 - ..... | .35 - ..... |

## MISCELLANEOUS

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Barytes, grd., white, bbl., ton. | $22.00-$25.00 | $22.00-$25.00 | $22.00-$25.00 |
| Casein, tech., bbl., lb. | .08½- .11 | .10 - .11 | .13 - .14 |
| China clay, dom., f.o.b. mine, ton. | 8.00 -20.00 | 8.00 -20.00 | 8.00 -20.00 |
| Dry colors | | | |
| Carbon gas, black (wks.), lb. | .02½- .30 | .02½- .30 | .04 - .30 |
| Prussian blue, bbl., lb. | .36 - .37 | .36 - .37 | .37 - .38 |
| Ultramarine blue, bbl., lb. | .10 - .26 | .10 - .26 | .10 - .26 |
| Chrome green, bbl., lb. | .21 - .30 | .21 - .30 | .21 - .27 |
| Carmine red, tins, lb. | 4.00 - 4.40 | 4.00 - 4.40 | 4.00 - 4.40 |
| Para toner, lb. | .75 - .80 | .75 - .80 | .75 - .80 |
| Vermilion, English, bbl., lb. | 1.50 - 1.55 | 1.45 - 1.50 | 1.75 - 1.80 |
| Chrome yellow, C. P., bbl., lb. | .14½- .15½ | .14½- .15½ | .13 - .14 |
| Feldspar, No. 1 (f.o.b. N.C.), ton. | 6.50 - 7.50 | 6.50 - 7.50 | 6.50 - 7.50 |
| Graphite, Ceylon, lump, bbl., lb. | .06 - .06½ | .06 - .06½ | .06 - .06½ |
| Gum copal Congo, bags, lb. | .06 - .30 | .06 - .30 | .08 - .30 |
| Manila, bags, lb. | .07 - .14 | .07 - .14 | .09 - .14 |
| Damar, Batavia, cases, lb. | .16 - .24 | .16 - .24 | .15½- .16 |
| Kauri cases, lb. | .17½- .60 | .17½- .60 | .19 - .25 |
| Kieselguhr (f.o.b. N. Y.), ton. | 50.00 -55.00 | 50.00 -55.00 | 50.00 -55.00 |
| Magnesite, calc, ton | 50.00 -..... | 50.00 -..... | 50.00 -..... |
| Pumice stone, lump, bbl., lb. | .05 - .07 | .05 - .08 | .05 - .07 |
| Imported, casks, lb. | .03 - .04 | .03 - .04 | .03 - .04 |
| Rosin, H., bbl. | 6.65 -..... | 5.35 -..... | 8.80 -..... |
| Turpentine, gal. | .27 -..... | .27½-..... | .32 -..... |
| Shellac, orange, fine, bags, lb. | .20 -..... | .20 -..... | .22 -..... |
| Bleached, bonedry, bags, lb. | .19 -..... | .19 -..... | .17½-..... |
| T. N. Bags, lb. | .11 -..... | .11 -..... | .12½-..... |
| Soapstone (f.o.b. Vt.), bags, ton. | 10.00 -12.00 | 10.00 -12.00 | 10.00 -12.00 |
| Talc, 200 mesh (f.o.b. Vt.), ton. | 8.00 - 8.50 | 8.00 - 8.50 | 8.00 - 8.50 |
| 300 mesh (f.o.b. Ga.), ton. | 7.50 -10.00 | 7.50 -10.00 | 7.50 -11.00 |
| 225 mesh (f.o.b. N. Y.), ton. | 13.75 -..... | 13.75 -..... | 13.75 -..... |

## INDUSTRIAL NOTES

THE U. S. INDUSTRIAL ALCOHOL CO., New York, has acquired the Stroock & Wittenberg Corp. The business in natural and synthetic resins of that corporation and of Robert Rauh, Inc., will be handled by the Stroock & Wittenberg Corp., 17 Battery Place, New York.

PERCO INCORPORATED, Bartlesville, Okla., has appointed Process Management Co., 120 E. 41st St., New York, as licensing agent for Perco copper sweetening process in territory east of the Mississippi.

CORK IMPORT CORP., 330 W. 42d St., New York, has appointed as distributors, A. H. Bennett Co., Minneapolis; The Bonitz Insulation Co., Greensboro, N. C.; Wm. S. Bryant, Salt Lake City; and A. W. Kuettel Co., Duluth.

GLYCO PRODUCTS CO., INC., New York, has appointed the following sales representatives: M. Romulo Vildoso, La Paz, Bolivia; R. R. Haagensen, Oslo, Norway; Einar Holmark, Copenhagen, Denmark; Tuteur & Co., Brussels, Belgium; and Eugen Boll, St. Gallen, Switzerland.

BENDIX AVIATION CORP., through its Julien P. Friez & Sons Division, Baltimore, has purchased the business of Nicostat Products, Inc., Buffalo, and will transfer the business to Baltimore.

MONSANTO CHEMICAL CO., St. Louis, has changed the name of its Fiberloid Division, with plant at Indian Orchard, Mass., to Plastics Division.

INDEPENDENT AIR FILTER CO., Chicago, has appointed F. H. Herzsch, 90 West St., as New York representative and Robert Arnold Sales & Engineering Co., 2221 N. Broad St. as Philadelphia representative.

PARAMET CHEMICAL CORP., Long Island City, has terminated its sales arrangement with Stroock & Wittenberg Corp., and has arranged to sell through regional sales agencies in the principal industrial centers.

# New CONSTRUCTION

## PROPOSED WORK

**Alcohol Plant**—Amherst Distillers, Ltd., W. F. Knight, Gen. Mgr., Amherstburg, Ont., Can., plans to construct an addition to its plant and purchase equipment for the manufacture of commercial and industrial alcohol. Estimated cost $50,000.

**Asphalt Plant**—City of St. Louis, c/o Baxter L. Brown, Pres., Board of Public Service, 304 City Hall St. Louis, Mo., contemplates the construction of an asphalt plant at Kingshighway Blvd. and De Tonty St., St. Louis. Estimated cost $50,000.

**Chemical Plant** — Cheney Chemicals, Ltd., 180 Duke St., Toronto, Ont., Can., plans to reconstruct its plant on Wickstead Rd., Leaside, Ont. Estimated cost $50,000.

**Chemical Laboratory** — Cole Chemical Co., Inc., B. L. Cole, Pres., 3721 Laclede Ave., St. Louis, Mo., will soon award the contract for the construction of a 2-story, part basement, 30x100 ft. and 55x120 ft. L-shaped chemical laboratory. Estimated cost $75,000.

**Creosoting Plant**—Injection Rapide et Conservation des Bois, Paris, France, plans to construct a plant for the creosoting of wood products at Montreal, Que., Can. Equipment will be purchased. Address Marquis de Liniers, Gen. Mgr., c/o Consulate of France, Montreal, Que. Estimated cost $150,000.

**Factory**—Cartier Waxed Paper Products, Ltd., St. Genevieve de Pierrefonds, Que., Can., is having plans prepared by Lafleur & Fortier, Archts., 507 Placed d'Avenes, Montreal, Que., Can., for the construction of a factory. Estimated cost $50,000.

**Factory**—The Clorox Chemical Co., c/o Carroll F. Morrison, Archt., and Engr., 221 North LaSalle St., Chicago, Ill., plans to construct a 1, 2 and 3-story, 102x362 ft. factory at 51st St. and Merrimac Ave., Chicago. Bids are now being received by architect and engineer. Estimated cost $300,000.

**Factory**—Hawkesbury Pulp Recovery Co., Ltd., J. Chapman, Gen. Mgr., Hawkesbury, Ont., Can., plans to construct a plant for the manufacture of cardboard boxes. Estimated cost $100,000.

**Factory**—Johnston Tin Foil & Metal Co., 6106 South Bway., St. Louis, Mo., will soon award the contract for the construction of a 1 story, 100x100 ft. brick and concrete addition to its factory. O'Meara & Hills, G. E. Quick, Assoc., 5709 Waterman Ave., St. Louis, Mo., Archts.

**Factory**—Pennsylvania Drug Co., 315 Poplar St., Scranton, Pa., has acquired a tract in Jefferson Avenue, Scranton, and plans to construct a 2-story drug products manufacturing plant and warehouse. Estimated cost $40,000.

**Factory**—Weldrods Co., subsidiary of Wilson Welder & Metals Co., Inc., J. E. Fricker, engineer in charge, 60 East 42nd St., New York, N. Y., will soon award the contract for the construction of a 1-story, 109x293 ft. factory on East 49th St. and Grand Ave., Cleveland, O.

**Factory**—West Coast Kalsomine Co., 5th and Grayson Sts., Berkeley, Calif., is having revised plans prepared for the construction of a part 1, 2, 3 and 4-story, 160x220 ft. factory. Former bids were rejected.

### Where Plants Are Being Built in Process Industries

| | Current Projects | | Cumulative 1938 | |
|---|---|---|---|---|
| | Proposed Work | Contracts | Proposed Work | Contracts |
| New England | ..... | $40,000 | $340,000 | $1,029,000 |
| Middle Atlantic | $80,000 | 50,000 | 8,804,000 | 8,073,000 |
| South | 50,000 | 34,000 | 21,620,000 | 12,086,000 |
| Middle West | 590,000 | 40,000 | 13,922,000 | 4,522,000 |
| West of Mississippi | 1,202,000 | 215,000 | 19,132,000 | 4,975,000 |
| Far West | 40,000 | 45,000 | 1,220,000 | 3,084,000 |
| Canada | 1,600,000 | ..... | 21,544,000 | 4,760,000 |
| Total | $3,562,000 | $424,000 | $86,582,000 | $38,529,000 |

**Gas Plant**—City, Canton, Kan., plans to construct a gas plant and distribution system. Estimated cost $37,000. Hefling & Hunter, Hutchinson, Kan., Archts.

**Laboratory**—U. S. Department of Agriculture, Washington, D. C., is having preliminary plans prepared for the construction of a 2-story research laboratory on Third St., Oklahoma City, Okla. Estimated cost $500,000.

**Oil Refinery**—British American Oil Co., Royal Bank Bldg., Toronto, Ont., Can., contemplates the construction of an oil refinery on 22nd St., E., Calgary, Alta. Estimated cost $300,000.

**Oil Terminal**—Campbell Oil Co., Long St., Chattanooga, Tenn., has acquired a three acre tract on the Tennessee River at Main St., Chattanooga, and is having plans prepared for the construction of an oil terminal. The Company plans to ship by water all of its incoming gasoline and oil. They serve 15 counties with Shell Oil products. Estimated cost $50,000.

**Oil Refinery**—Gulf Refining Co., Gulf Bldg., Pittsburg, Pa., plans to construct an addition to bulk distributing plant at Monsey Ave. and Ash St., Scranton, Pa., including enlargement of storage facilities and 1-story office building. Estimated cost including equipment $40,000.

**Oil Refinery**—Mid-Continent Petroleum Co., Cosden Bldg., Tulsa, Okla., plans to construct a new plant for the refining of lubricating oils and waxes at its plant in West Tulsa. Estimated cost $500,000.

**Oil Refinery**—Ohio Oil Co., Donnell Bldg., Findlay, Ohio, plans to rebuild that portion of its crude oil refinery at Robinson, Ill., recently damaged by fire with a loss of $250,000. Ray Lupton is general plant superintendent.

**Oil Terminal**—Sinclair Prairie Oil Co., Corpus Christi, Tex., will not construct huge oil terminal including steel storage tanks, loading facilities and probably refinery just outside of Portland, Tex. Project has been abandoned for the present. Estimated cost $1,000,000.

**Zinc Refinery**—Province of Quebec, Hon. O. Gagnon, Minister, Department of Mines, Game & Fisheries, Quebec, Que., Can., is having plans prepared for the construction of a zinc refinery. Estimated cost $900,000.

## CONTRACTS AWARDED

**Enameling Plant** — Hussman-Ligonier Co., 2401 North Leffingwell Ave., St. Louis, Mo., has awarded the contract for the construction of a 1 story, 101x161 ft. enameling plant for refrigerator manufacturing plant to Wm. & Nelson Cunliff Co., 3320 Lindell Blvd., St. Louis, Mo. Estimated cost $75,000.

**Plant**—American Enka Corp., Enka, N. C., has awarded the contract for the construction of a cake bleach extension to Potter & Shackelford, Inc., Greenville, S. C., at $33,660.

**Plant**—Raybestos-Manhattan Co., 1427 Railroad Ave., Bridgeport, Conn., has awarded the contract for the construction of a plant including office building, shipping room, laboratory and garage, also storage unit at Stratford, Conn., to O. F. Burghart, 333 North Ave., Bridgeport, Conn. Estimated cost $40,000.

**Pumphouse**—Standard Oil Co. of California, 225 Bush St., San Francisco, Calif., will construct foundations for proposed pumphouse in area bounded by Irwin, Hubbell, 7th and 8th Sts., San Francisco. Work will be done by day labor under supervision of owners. Estimated cost of foundations only $45,000.

**Storage Building**—Fort Dodge Serum Co., Fort Dodge, Ia., has awarded the contract for the construction of a storage, warehouse and office building to M. J. Grosz, Fort Dodge. Estimated cost $40,000.

**Warehouse**—Lawless Bros. Paper Mills, Inc., East Rochester, N. Y., has awarded the contract for the construction of a 1-story, 55x240 ft. warehouse to Pittsburgh Des Moines Steel Co., Neville Island, Pittsburgh, Pa. Estimated cost will exceed $40,000.

**Warehouse**—Monsanto Chemical Co., 1700 South Second St., St. Louis, Mo., has awarded the contract for the construction of a warehouse for its phosphate plant to Fruin-Colmon Contracting Co., 502 Merchants Laclede Bldg., St. Louis. Estimated cost $100,000.

**Warehouse**—National Paper Co., 832 West Hubbard St., Chicago, Ill., has awarded the contract for the construction of a warehouse at Hubbard and Green Sts., to R. Busa & Sons, 1700 Narragansett Ave., Chicago. Estimated cost $40,000.

# CONSUMPTION OF SPECIALLY DENATURED ALCOHOL BY INDUSTRIES

IN a report released by the Alcohol Tax Unit of the Bureau of Internal Revenue, it is shown that domestic consumption of specially denatured alcohol for the fiscal year ended June 30, 1937, amounted to 139,109,095 wine gallons, including the amount recovered and reused. As 60,800,575 wine gallons were recovered and reused, the net total of specially denatured alcohol consumed in that fiscal year was 78,308,520 wine gallons.

The report divides consuming industries into eight main divisions and also gives a breakdown for the respective divisions. According to this arrangement, the largest outlet for specially denatured alcohol was as a raw material for conversion into chemical products. For that purpose a grand total of 59,618,929 wine gallons was used, this total including 25,200,422 wine gallons which had been recovered and reused, thus leaving an actual consumption of 34,418,507 wine gallons. If the figure given for use as a solvent and thinner for cellulose and resin products is added to the amount used in producing cellulose and resin products, the total for that industry would be represented by 32,639,341 wine gallons used of which 4,158,921 wine gallons had been recovered and reused, thus indicating net consumption of 28,480,420 wine gallons.

Processing industrial, food, drug, and other products required a large amount of specially denatured alcohol but the percentage of recovery was so high that consumption in terms of disappearance of alcohol was relatively small, the totals being 36,470,653 wine gallons used, 31,373,853 wine gallons recovered and reused, 5,096,800 wine gallons actually consumed.

The largest uses for specially denatured alcohol as a raw material in the manufacture of chemicals were found in producing aldehydes, ethyl acetate, ethyl chloride, and for conversion into vinegar. Production of aldehydes required 27,160,082 wine gallons of which 17,447,508 wine gallons represented recovered and reused alcohol, leaving a net consumption of 9,712,574 wine gallons. The figures for ethyl acetate production were 8,514,740 wine gallons as the total, 300,818 wine gallons recovered and reused, and 8,213,912 wine gallons net.

### Specially Denatured Alcohol Used in Fiscal Year Ended June 30, 1937

| | Amount Used Including Reused Wine Gal. | Amount Recovered For Reuse Wine Gal. |
|---|---|---|
| Cellulose, resin, and related products | 15,926,637 | 4,158,921 |
| Solvents and thinners for cellulose and resin products | 16,712,704 | ... |
| Processing industrial, food, drug, and other products | 36,470,653 | 31,373,853 |
| Toilet preparations and related products | 3,779,359 | 261 |
| Pharmaceutical products for external use | 3,959,980 | ... |
| Cleaning, preserving, and flavoring preparations | 2,169,007 | 65,962 |
| Converted as raw material in chemical manufacturing | 59,618,929 | 25,200,422 |
| Fluid, fuel, and other uses | 470,670 | 1,156 |
| Total | 139,109,095 | 60,800,575 |

### Plastics

| | Amount Used Wine Gal. | Recovered For Reuse Wine Gal. |
|---|---|---|
| Cellulose compounds | 1,787,550 | 994,177 |
| All other plastics | 1,809,274 | 51,378 |
| Total | 3,596,824 | 1,045,555 |

### Other Cellulose and Resin Products

| | Amount Used Wine Gal. | Recovered For Reuse Wine Gal. |
|---|---|---|
| Photographic film | 1,286,656 | 790,609 |
| Transparent sheeting | 834,870 | 532,036 |
| Cellulose intermediates | 742,580 | 377,722 |
| Explosives | 355,497 | 160,526 |
| Polishes | 271,424 | ... |
| Adhesives | 137,960 | 6,639 |
| Soldering flux | 132,014 | ... |
| Inks, stains, and dye solutions | 97,976 | 93 |
| Total | 3,858,977 | 1,867,625 |

### Lacquers, Varnishes, and Enamels

| | Amount Used Wine Gal. | Recovered For Reuse Wine Gal. |
|---|---|---|
| Cellulose | 2,984,652 | 1,096,228 |
| Synthetic resins | 214,345 | 77,305 |
| Shellac | 4,056,972 | 72,208 |
| Other natural resins | 1,108,522 | ... |
| Candy glazes | 55,295 | ... |
| Coatings from other materials | 51,050 | ... |
| Total | 8,470,836 | 1,245,741 |

### Processing Industrial, Food, Drug, and Other Products

| | Amount Used Wine Gal. | Recovered For Reuse Wine Gal. |
|---|---|---|
| Dehydrated nitrocellulose | 16,972,882 | 14,010,810 |
| Petroleum oils | 3,317,140 | 3,085,009 |
| Pectin | 6,720,960 | 6,553,111 |
| Other food products | 103,401 | 84,594 |
| Drug products | 6,250,712 | 5,324,848 |
| Sodium hydrosulphite | 1,091,872 | 995,838 |
| Dyes and intermediates | 561,304 | 332,127 |
| Other chemicals | 876,599 | 639,063 |
| Miscellaneous products | 575,783 | 348,453 |
| Total | 36,470,653 | 31,373,853 |

### Toilet Preparations and Related Products

| | Amount Used Wine Gal. | Recovered For Reuse Wine Gal. |
|---|---|---|
| Hair and scalp preparations, exclusive of shampoos | 1,004,891 | ... |
| Shampoos | 189,552 | 261 |
| Bay rum | 387,520 | ... |
| Other face and hand lotions | 529,820 | ... |
| Toilet waters | 565,884 | ... |
| Perfume and perfume tinctures | 235,022 | ... |
| Toilet soaps (including shaving cream) | 35,271 | ... |
| Mouth washes | 799,465 | ... |
| Tooth pastes and powders | 31,934 | ... |
| Total | 3,779,359 | 261 |

### Cleaning, Preserving, and Flavoring Preparations

| | Amount Used Wine Gal. | Recovered For Reuse Wine Gal. |
|---|---|---|
| Tobacco sprays and flavors | 1,557,931 | ... |
| Cleaning preparations | 410,185 | 65,962 |
| Deodrant sprays | 55,068 | ... |
| Disinfectants, insecticides, etc. | 35,338 | ... |
| Sterilizing and preserving solutions | 32,819 | ... |
| Embalming fluids | 30,859 | ... |
| Industrial soaps | 20,981 | ... |
| Miscellaneous | 25,826 | ... |
| Total | 2,169,007 | 65,962 |

### Converted as a Raw Material in Chemical Manufacturing

| | Amount Used Wine Gal. | Recovered For Reuse Wine Gal. |
|---|---|---|
| Vinegar | 5,065,335 | ... |
| Ethyl acetate | 8,514,740 | 300,818 |
| Ethyl chloride | 7,466,436 | ... |
| Other ethyl ethers | 694,023 | 345,718 |
| Dyes and intermediates | 767,545 | 380,605 |
| Aldehydes | 27,160,082 | 17,447,508 |
| Ethyl ether | 891,340 | 192,906 |
| Other ethers | 7,280,882 | 6,472,210 |
| Ethylene bromide | 503,325 | ... |
| Xanthates | 467,290 | ... |
| Fulminate of mercury | 205,514 | 19,666 |
| Ethylene gas | 530,396 | 34,166 |
| Miscellaneous | 72,021 | 6,825 |
| Total | 59,618,929 | 25,200,422 |

### Fluid Uses

| | Amount Used Wine Gal. | Recovered For Reuse Wine Gal. |
|---|---|---|
| Brake fluids | 64,323 | ... |
| Cutting oils | 26,266 | ... |
| Other fluid uses | 61,721 | ... |
| Total | 152,310 | ... |

### Solvents and Thinners for Cellulose and Resin

| | |
|---|---|
| Proprietary solvents | 14,851,090 |
| Other industrial thinners | 1,861,614 |
| Total | 16,712,704 |